ACRP

REPORT 35

AIRPORT COOPERATIVE RESEARCH PROGRAM

Sponsored by the Federal Aviation Administration

Planning for Offsite Airport Terminals

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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP REPORT 35

Planning for Offsite Airport Terminals

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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FOREWORD

By Michael R. Salamone
Staff Officer
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ACRP Report 35: Planning for Offsite Airport Terminals provides information for airports that wish to serve urban or suburban originating passengers with remote terminal facilities. Airport planners (including facility, operations, environmental, and development) will find the report helps to identify potential customers for an offsite terminal and how the concept fits into airport planning.

The report can be used in three ways. First, those in the airport industry interested in the concept can use the information in the conclusions and recommendations to determine whether the concept merits their consideration, based on existing and anticipated operational issues and long-term goals and objectives for the airport/region. Second, those in the industry interested in pursuing the development of offsite terminals can use the detailed information in the report to determine geographic market areas to be served by an offsite terminal and the potential number of customers. Third, those interested in developing an offsite terminal can use the planning guide as a roadmap for the process.

It is important for an airport to establish goals and objectives prior to evaluating the feasibility of offsite terminals. A planning guide provides practical assistance to airport staff and other decisionmakers when planning and developing an offsite terminal and airport transportation link. It is intended to guide project elements and issues that are common to most offsite terminal projects, with the recognition that circumstances at an individual airport may warrant deviations from the recommendations in the guide.

Under ACRP Project 10-02, MarketSense Consulting LLC of Boston, MA, was asked to investigate and present the most current knowledge related to the operation of remote airport terminals and to develop guidance, which was based upon airport experience to assist airports in the planning, design, and implementation of such an offsite facility. The research focused on a handful of domestic case studies, which provide a summary of current information and practice on the concept of off-airport passenger processing. Two international locations were also examined for the potential benefit of domestic airports. The case studies look at airport characteristics, market research data, ridership trends, information on branding/marketing/advertising, motivation for developing the offsite terminal, amenities, and financial information.

CONTENTS

Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

CHAPTER 1

Introduction

Guide Purpose

The purpose of this planning guide is to provide practical assistance to airport staff and other decisionmakers when planning and developing an offsite terminal and airport transportation link in the United States. The information herein is based on experience gained at airports within the United States and abroad. The goal is to provide guidance on major project elements and issues that are common to most offsite terminal projects. Rules of thumb and courses of action are provided to assist with project development, although some airport environments may require the user to deviate from this guide. Offsite terminals are a relatively new concept in the United States, so new models may evolve.

The chapters in this guide are largely discrete, allowing the project sponsor to review information on topics that are relevant to the program under consideration without reviewing the entire guide. However, the planning concepts in each of the chapters are interrelated, and it is recommended that consideration be given to all of the topics, whether or not the entire guide is used. The chapters are as follows:

- Chapter 1: Introduction
- Chapter 2: Rationale for an Offsite Terminal
- Chapter 3: Market Determination
- Chapter 4: Project Definition and Planning
- Chapter 5: Costs and Benefits
- Chapter 6: Plan of Finance and Financial Feasibility
- Chapter 7: Branding, Advertising, and Customer Service
- Chapter 8: Implementation Guidelines
- Chapter 9: Performance Monitoring

Backup materials for the majority of information presented in this guide can be found in the Final Report for ACRP Project 10-02, available at the TRB website (trb.org).

Definitions and Assumptions

The following definitions are used and assumptions made within this planning guide:

- ***Airport Users, Airport Customers:*** Airline passengers, airport employees, meeters/greeters, and other persons using airport facilities.
- ***Project Sponsor:*** In most cases, an offsite terminal and a transportation link will be developed by an airport operator, or the airport operator will have some input into the process. The information in this planning guide will also be useful for other public entities and, to some degree, to

private-sector project proponents. Generally, the motivation for the private-sector to undertake such a project is for profit—this is usually not the motivation for a public-sector project sponsor.

- ***(Airport) Transportation Link:*** The most flexible and cost-effective link between the offsite terminal and the airport will be via bus; however, most of the information in the guide is also applicable to a rail link. The link will be for airport users only.
- ***Offsite Terminal:*** A building, or an exclusive location within a shared-use building, that has some characteristics of an airport terminal but is off-airport. It facilitates the transfer of airport customers between travel modes by providing parking and proximity to intermodal connections where appropriate. Some amenities and services are offered, including a comfortable waiting area in an enclosed climate-controlled environment. There may also be the option to check baggage and to receive boarding passes. The transportation connection between the offsite terminal and the airport is a scheduled bus or rail service operating year-round that is used exclusively for the transport of airport customers. The offsite terminal may be introduced into an airport user market in conjunction with the introduction of a new airport transportation link, or it may be introduced to serve customers where an airport transportation link already exists. An airport transportation link can be successful without an offsite terminal, but an offsite terminal will not be successful without a customer-responsive airport transportation link.

CHAPTER 2

Rationale for an Offsite Terminal

Development of Goals and Objectives

A crucial first step in the development of an offsite terminal and transportation link is for the project sponsor to define the project's goals and objectives. If some of the recommendations in this document are counter to the goals and objectives for a specific offsite terminal project, the project sponsor should make decisions that are appropriate for the project.

It is important for the project sponsor to define the purpose of the offsite terminal within its operating environment, what it hopes to accomplish, and the resources it is willing to make available. Clear goals and objectives will help to shape the project, facilitate its development among various departments that may have different objectives within the sponsoring organization, and provide the project sponsor with guidelines for measuring success once the offsite terminal and transportation link are operational.

Motivation for an Offsite Terminal

During the project planning and development process, individuals involved with the project must understand the motivation behind establishing the offsite terminal. There are many reasons why the project sponsor may consider introducing an offsite terminal and transportation link, including the following reasons.

- Mitigation measure:
  - Congested conditions on airport roads and terminal curbs, within the region and within airport-impacted communities, due to low-occupancy-vehicle trips generated by airport users and
  - Environmental impacts.
- Space constraints:
  - Parking,
  - Airport roads and terminal curbs, and
  - Terminal Area.
- Financial:
  - Cost of development on-airport versus off-airport.
- Customer Service:
  - Provide airport users with excellent high-occupancy transportation options to the airport,
  - Easy access to airport,
  - Competition with other airports, and
  - Serving a specific customer group.

- Political:
  - Move airport impacts away from the airport-impacted area and
  - Provide a service to constituents of the offsite-terminal market area.
- Use of Available Property:
  - Specific parcel and
  - Intermodal center or joint-use development.

Once the project sponsor has established the reasons for considering an offsite terminal and transportation link, expected results of the project and how to achieve these results must be considered to ensure the alignment of objectives within the sponsoring organization.

Developing Goals and Objectives

The planning and development of an airport offsite terminal and transportation link will involve participation and teamwork from individuals with expertise in many disciplines including facilities planning, transportation planning, finance, business development, risk management, environmental, operations, property and facilities management, engineering, legal, and public safety. Since individuals working in different disciplines offer varying perspectives on what constitutes success, it is important to establish clear goals and objectives. Clearly defined goals and objectives will maximize the effectiveness of all who contribute to the project.

Scenarios can be developed where the potential positive and negative outcomes of decisions related to project planning, development and operations are revealed. Comparisons among scenarios will expose potential tradeoffs to be made among different project parameters that allow the project sponsor to achieve project goals within the context of the overall goals and objectives of the sponsoring organization. For example, scenario analysis can be used to understand the relationship among cost, timing, scale of the project, level of service, and customer service. This type of analysis will provide direction on whether to go forward with a project, how to prioritize project elements, how to refine the project, and how to develop milestones. Some ideas to explore include, but are not limited to,

- Ensuring the targeted accomplishments are realistic within the overall budgetary and operational goals of the organization;
- Consideration of alternatives that may offer similar results;
- Impact of project costs (capital and operating) on the overall financial plan of the organization;
- Maximum amount of staffing and financial resources available for the project;
- Exit strategy or alternative plan if the project doesn't meet goals;
- Potential consequences if project doesn't meet goals;
- Potential risks to the sponsoring organization;
- The sponsoring organization's risk tolerance for the project;
- Where the project will be managed and maintained within the organization;
- Project sponsors' ability to undertake the project;
- Project timeline in context of targeted accomplishments;
- Project benefits;
- Environmental impacts of project;
- Political impacts of project;
- Operational impacts of project; and
- Public acceptance of the project – airport users and community surrounding offsite terminal.

The previous topics can be narrowed to determine whether realistic goals and objectives can be developed for the project within the context of the sponsoring organization. To do this, impacts and relationships in the following categories must be considered.

- Financial implications:
  - Impact of profit, breakeven, loss on
    - Sponsoring organization and
    - Level of service of offsite terminal and transportation link;
  - Revenue diversion;
  - Capital costs;
  - Operating costs;
  - Loss of on-airport revenue due to fewer parking exits; and
  - Passenger fares
    - Impact on ridership levels,
    - Relationship to other access/egress modes,
    - Political,
    - Customer service, and
    - Operational impacts.
- Ridership objectives:
  - Maximize ridership, minimum ridership threshold, or optimize given other considerations.
- Relationship to on-airport development:
  - Reducing, postponing, or eliminating the need for specific on-airport development projects;
  - Mitigation measure allowing airport development; and
  - Reducing available funding for priority on-airport projects.
- On-airport operational impacts:
  - Alleviates or prevents undesirable levels of customer service or inefficient operations for
    - Roadway congestion,
    - Terminal curb congestion,
    - Automobile parking supply, and
    - Crowded terminals; and
  - Negative impact on operations, such as additional curb space for transportation link.
- Reduce off-airport impacts—airport-impacted areas and within the region:
  - Low-occupancy-vehicle trips,
  - Vehicle-miles traveled,
  - Air-quality impacts/vehicle emissions, and
  - Fuel consumption.
- Competition with area airports:
  - Potential for offsite terminal/transportation link making airport more competitive.
- Customer Service:
  - Level of service, transportation link;
  - Relationship of service frequency and hours of operation to flight schedule; and
  - Customers
    - Air passengers,
    - Airport employees,
    - Meeters/greeters, and
    - A specific customer group, such as pleasure travelers or passengers being picked up and dropped off in a private automobile.
- Partnering:
  - Will partnerships with the public or private sector result in a better/faster/easier/more cost effective/more politically feasible project?

The above categories may not include all of the factors that are important to the sponsoring organization. The list is exhaustive enough to demonstrate that there are many reasons to

consider offering an offsite terminal and transportation link and subsequently measuring its success. The project proponent must decide what it wants to accomplish, recognizing there will be tradeoffs. For example, it may not be realistic to both maximize ridership and maximize revenue.

During project planning and development, it is advisable to continuously compare specific elements of the project with the project goals and objectives to ensure the project is on track. Project elements or goals and objectives may need to be redefined during the process.

CHAPTER 3

Market Determination

This chapter presents the steps required to conduct a market analysis for an offsite terminal. In this application, the market analysis focuses on the location and number of potential customers and provides an objective measure for estimating offsite terminal use. Identifying a location convenient to the largest number of potential customers establishes a standard against which other offsite terminal locations can be measured. As presented in Chapter 2, there are various reasons to develop offsite terminals; analyzing the customer market provides valuable data for a proposed development regardless of the underlying rationale.

The following topics are discussed in this chapter:

- Information sources, data requirements, and data processing for the market analysis;
- How to conduct an offsite terminal market analysis and considerations when using the analysis results; and
- A checklist for the offsite terminal market analysis.

The procedure described in this chapter is flexible and can be used to analyze various offsite terminal scenarios. For example, it can be used to evaluate the customer market for multiple offsite terminals or the market associated with a specific location. It is based on an understanding of airport ground access customers—those who travel to and from an airport by some form of ground transportation.

The information presented in this chapter is based on an analysis of offsite terminals serving Los Angeles International Airport (LAX) and Boston Logan International Airport (BOS) and on the application of market factors from four additional airports: Seattle-Tacoma International Airport (SEA), Denver International Airport (DIA), Phoenix Sky Harbor International Airport (PHX), and Houston George Bush Intercontinental Airport (IAH). LAX and BOS are the only commercial airports in the United States with offsite terminals operated by the airport operator. A complete discussion of the research supporting this chapter is found in the Final Report for ACRP Project 10-02, which is available on the TRB website (trb.org).

Data Requirements and Processing

The most important information needed to analyze the market for an offsite terminal is the location where potential customers start their trip to the airport. Determining how many customers originate from individual locations requires an understanding of an airport's local ground access market. Importing this information into a database that can be used for analysis is accomplished using geographical information system (GIS) software. Although it is possible to conduct an offsite terminal market analysis without the aid of GIS software, it is not recom-

mended since an important part of the analysis is spatial—the geographic relationship between the airport and the origin points for airport customers' access trips.

Airport Customer Segments

Market segmentation is used in all facets of research and planning today and helps target a product or service to the group or groups most likely to find it useful. Market segments are important to this analysis because they divide airport users into distinct groups having one or more characteristics in common. Empirical data from existing offsite terminals provides information about market segments that can then be applied to the analysis of new market areas. In other words, analyzing who uses existing offsite terminals aids in identifying the market for new offsite terminals.

Air Passengers

The principal user of an offsite terminal is the air passenger, the customer an offsite terminal is designed to serve. Airports serve both origin/destination (O/D) and transferring air passengers while offsite terminals serve only origin/destination air passengers. Origin/destination air passengers travel to the airport by some form of ground transportation and can be further divided into two groups: residents who live in the region served by the airport and non-residents who live outside the local region. Segmenting air passengers into residents and non-residents is important because it reveals two factors that influence air passengers' decisions to use an offsite terminal: private vehicle availability and origin location type. Collectively, the access mode choices of air passengers and the origin points for their trips to the airport result in patterns of activity that can provide useful information when planning new facilities.

Resident air passengers have the following characteristics:

- They live within the region. The airport is their home airport. Residents typically have a personal vehicle available for their use. The majority of residents start their trip to the airport from home.
- They are familiar with available ground access choices to reach their home airport.
- They are the primary customer of the long-term parking supply at the airport since their private automobiles are based in the region.
- They are responsible for a significant number of pick-ups/drop-offs by private automobile.

Non-resident air passengers have the following characteristics:

- They live outside the region. Their home airport is elsewhere. All non-residents start their trip to the airport from somewhere other than their own home—for example, someone else's home, a hotel, a school, or a place of work.
- They are less likely to be familiar with specific ground access choices for the airport they are visiting and are probably only familiar with generic choices such as taxi, door-to-door van, and subway.
- Pick-up/drop-off by private automobile is only available if they know someone who lives in the area.
- They are responsible for 100% of rental car use. They typically use a rental car for day-to-day travel and for the trip to and from the airport.

Airport Employees

The second group or segment of potential offsite terminal customers is airport employees. Many major U.S. airports have significant numbers of employees. Distinguishing characteristics are their work schedules, how many days per week they work, and the on airport location of their employment.

Although offsite terminals are planned primarily for use by air passengers, an increasing number of airport employees are also using them. Airport employees should be considered a supplemental market to be served by the offsite terminal and transportation link when they live in the same area as those in the air passenger market. Employees can be segmented into the following categories:

- Airline (flight crew and non-flight crew);
- Airport operator;
- Full-time and part-time; and
- Shift and non-shift workers.
- Workers with multiple part-time jobs.

As with air passengers, airport employee travel patterns will vary by segment.

Information Sources for Airport Customer Segments

Air Passengers

The principal source of information about air passengers is usually an air passenger survey. ***An offsite terminal market analysis cannot be completed without reliable and detailed data indicating where air passengers begin their ground access trip to an airport.*** This statement cannot be overemphasized. Furthermore, the number of records included in the survey sample must be of sufficient quantity to distinguish geographic patterns of air passenger activity. Often, an airport conducts a survey for another purpose such as determining passengers' satisfaction with various airport services and amenities or to understand the activity associated with peak travel periods. The type of survey used is not relevant as long as the crucial origin data is collected. However, there is a problem if the results from peak-period surveys are used. By definition, these surveys are measures of an extreme period of airport activity and will not be representative of activity patterns for the majority of the year. Therefore, if peak-period surveys are used, the results must be adjusted to represent average patterns of activity at the airport.

An important consideration when using air passenger survey data for offsite terminal market analysis is the size of the survey sample. For market analysis, the sample size should provide data for the majority of analysis zones (zip codes or other geographic units) within 30 miles of the airport for the two major segments of air passengers, residents and non-residents. Based on average annual day enplaning passengers and assuming 50% resident and 50% non-resident air passengers, the recommendation is to have a minimum sample size of 25%—that is, if there are 30,000 originating air passengers on an average day, the minimum sample size is 7,500 completed surveys, 3,750 resident and 3,750 non-resident.

The basic information that should be collected in an air passenger survey includes

- Whether the respondent is a resident or non-resident of the region (the definition of resident is determined locally);
- Where the respondent started their local trip to the airport (i.e., zip code, address, or landmark);
- The primary purpose of the air travel (i.e., business or non-business); and
- The mode of access used to the airport.

Only the first two pieces of information are needed to conduct the market analysis; however, trip purpose and access mode data provide additional information that is useful when planning an offsite terminal.

Airport Employees

An employee travel survey is an excellent source of information about airport employees, but very few airports have conducted this type of survey. In the absence of employee surveys, there

are ways to estimate the distribution of employee origins in the region. Today, all airports have security badge systems that include most or all airport employees. Aggregating the number of badges by zip code or other geographic unit provides a way to estimate the number and origin locations for airport employees. Then, assuming some proportion of total employees comes to the airport on an average day and applying that percentage to total badges provides an estimate of average day employees. Airport employee home zip codes should be scaled to represent average annual day inbound airport trips. When making the estimation about average daily employee trips to the airport, the analyst should keep in mind that employees are required to staff the airport during all operating hours, which at many airports is 24 hours per day, 7 days per week, and 365 days per year.

Processing Airport Customer Origin Trip Data

The discussion of airport customer data will focus on air passengers. The suggested zonal system for the market analysis is zip codes, although any type of zonal system can be used. Zip code zones provide sufficient detail for conducting a market analysis, and there is a wealth of secondary data available in the same format.

Processing air passenger survey data involves the preparation of a file listing the number of resident air passengers by zip code and the number of non-resident air passengers by zip code. In many cases, there will a limited number of non-resident records with zip code information because many non-residents do not know the zip code for their local origin. As discussed in a later section, zip code origins for resident air passengers is the most important information needed for the market analysis because resident air passengers are the principal customers for offsite terminals.

Survey records for resident and non-resident air passengers are scaled to represent average day enplaning air passengers in 2006. Any measure of air passengers can be used to describe the primary market; however, the analysis completed for this project uses average annual day enplaning (AADE) air passengers as the standard metric. To compare analysis results from an individual airport to the benchmarks provided, one must use the same measure of air passengers. If non-resident air passenger and airport employee information is available by zip code, the same procedures apply. Total annual passengers can be easily calculated by doubling average day enplaning air passengers to equal total daily passengers and then multiplying by 365.

The scaled air passenger data—resident air passengers by zip code and non-resident air passengers by zip code—should then be linked to a geographic data base so that the information can be displayed spatially on a base map of the region. The base map should include major regional roadways, the location of transit and rail stations, and the zip code zones (or other geographic zones used in the analysis). The product is a zip code–based map file with survey data representing AADE air passengers. Employee trip data, if available, should be factored to represent average annual day inbound airport trips. Table 1 illustrates the steps taken to estimate 2006 AADE resident air passengers.

Table 1. Estimation of average annual day enplaning (AADE) resident air passengers.

	Formula	Product
Step 1	(2006 O/D air passengers x percent residents) / 365 / 2	2006 AADE resident air passengers
Step 3	Link air passenger survey file to map, summarize by zip code, and weight by resident scaling factor	2006 AADE resident air passengers by zip code zone

Source: MarketSense Consulting

Customers of Offsite Terminals in Suburban Locations

The existing offsite terminals for which empirical data is available are found in highway based suburban locations. By necessity, the description of the market analysis in this chapter will rely heavily on the characteristics of the suburban type. Suburban offsite terminals are primarily used by resident air passengers. Many non-resident air passengers, if not visiting friends or family in suburban locations, are destined for areas focusing on business and pleasure activities, which tend to be concentrated in specific areas of the region (e.g., downtown or tourist attractions). Most resident air passengers begin their trip to the airport from home, making them ideal customers for conveniently located suburban offsite terminals.

Customers of Offsite Terminals in Downtown Locations

Currently, there is only one offsite terminal at a downtown location with nonstop express transportation to the airport—the Union Station FlyAway serving Los Angeles International Airport. It is located at an intermodal facility having local, regional, and long-distance public transportation access. The airport is located 20 miles away and prior to the introduction of the Union Station FlyAway, there was no direct access from the terminal to the airport except by taxi.

The Union Station offsite terminal has been in existence for less than 2 years, so minimal data about customer segments is available. Early indications from Union Station suggest that downtown offsite terminals will differ from suburban offsite terminals in the way customers access them and the proportional use by resident and non-resident market segments. Although resident air passengers appear to be the primary market segment using the downtown offsite terminal, there is a higher proportion of non-resident air passengers using them compared with their use of suburban offsite terminals.

Offsite Terminal Market Analysis

The typical offsite terminal in the United States is the suburban terminal. This is the prototype for which most of the historical data is available. As previously mentioned, the downtown offsite terminal is emerging as a second type of facility for which much less information is available. Conceptually, the location and market principles described in the following sections apply to either type of facility; however, in practice, the suburban facility is tied to the road network and the downtown facility is tied to the public transportation network, resulting in significant differences in the way each type of terminal is accessed.

Step 1: Review the Regional Roadway and Transit Network for Offsite Terminal Locations and Select an Anchor Node and Zone for the Market Analysis

Identify Potential Offsite Terminal Locations on the Transportation Network

The first task uses a large scale view of the transportation infrastructure of the region to evaluate the primary travel paths to the airport. It is important to consider the regional roadway network and the location of the airport within the network. The objective of the following guidelines is to identify locations for offsite terminals that would serve the major regional highway corridors in the region without overlap in their coverage.

Distance from the Airport: Identify Points on the Roadway Network at Least 10 to 15 Miles from the Airport. Existing offsite terminals are typically located at a minimum distance of 10 to 15 miles from the airport, or at least 30 minutes driving time, to optimize potential ridership.

The purpose of ascribing a minimum distance from the airport reflects the willingness of travelers to stop somewhere along their customary travel path to the airport and transfer to another mode. At points close to the airport, the majority of the airport access trip has been completed for airport users who have traveled significant distances and, therefore, there is less perceived convenience and/or time savings for the traveler to change modes. The potential customer will weigh the time it takes to exit the highway, park at the terminal, and wait for the next departing bus to the time it takes to continue directly to the airport in a private automobile or taxi. At closer distances to the airport, an offsite terminal may not be viable without a high concentration of air passenger origins in proximity to the offsite terminal. Furthermore, if the offsite terminal is too close to the airport, it will compete with off-airport parking facilities that typically offer frequent complimentary shuttle service (the shuttle price is built into the daily parking fee).

Directness of Path: Identify Major Highway Corridors Where Airport Access Routes Are Crossed by Other Major Highways. A location accessible from more than one highway corridor will attract more air passengers than a location with poor accessibility. Few air passengers will backtrack or divert from their normal travel path to reach an offsite terminal. Air passengers and airport employees are potential customers for an offsite terminal if it is located somewhere along the typical route they use to reach the airport. When the offsite terminal is located along the airport user's typical route to the airport, it is perceived to be a stop along the same route the customer would have taken to the airport rather than a detour. For a terminal that offers good intermodal connections, some air passengers and airport employees who want to avoid driving or taking a taxi to the airport may be willing to take public transportation to and from the offsite terminal even if it requires backtracking or sacrificing directness of path. The directness of path guideline also applies to automobile access to terminals with intermodal connectivity.

Relationship to the Regional Transportation Network: Proximity of Offsite Terminal to Roadway and/or Transit Networks. The location of an offsite terminal within a regional transportation corridor is crucial to its success. For a suburban terminal, it must be close to one major regional highway or freeway, or the intersection of two major highways, so that the roadway network can channel airport-bound traffic toward the facility. In particular, intersecting radial and circumferential highways or the intersection of any two major routes are desirable locations for offsite terminals. The combination of proximity to the transportation network and a location at a distance of 10 to 15 miles from the airport ensures good access for customers from greater distances in addition to those who are close by.

The suburban offsite terminal should be at a location that offers good access from the regional road network, ideally not more than a 5-minute drive from the on and off ramps of a major regional access route. In some cases, a less than optimal location will be perceived as being readily accessible if it is visible from the major regional route used to reach the site. It is preferable to locate the offsite terminal at a transition point between a relatively non-congested route and a congested route to the airport. If the route to the airport also offers a high-occupancy-vehicle (HOV) lane, customers will realize additional time savings compared with driving to the airport alone. A downtown offsite terminal must have excellent connections to regional and long-distance rail and bus services and be accessible by automobile and taxi.

Proximity to Regional Activity Centers. An offsite terminal located near a significant regional facility will benefit from its exposure to traffic generated by that facility. A major regional shopping center of at least 500,000 square feet or an entertainment complex is optimally positioned for maximum visibility and accessibility by large numbers of potential customers. This applies to both suburban and downtown terminals.

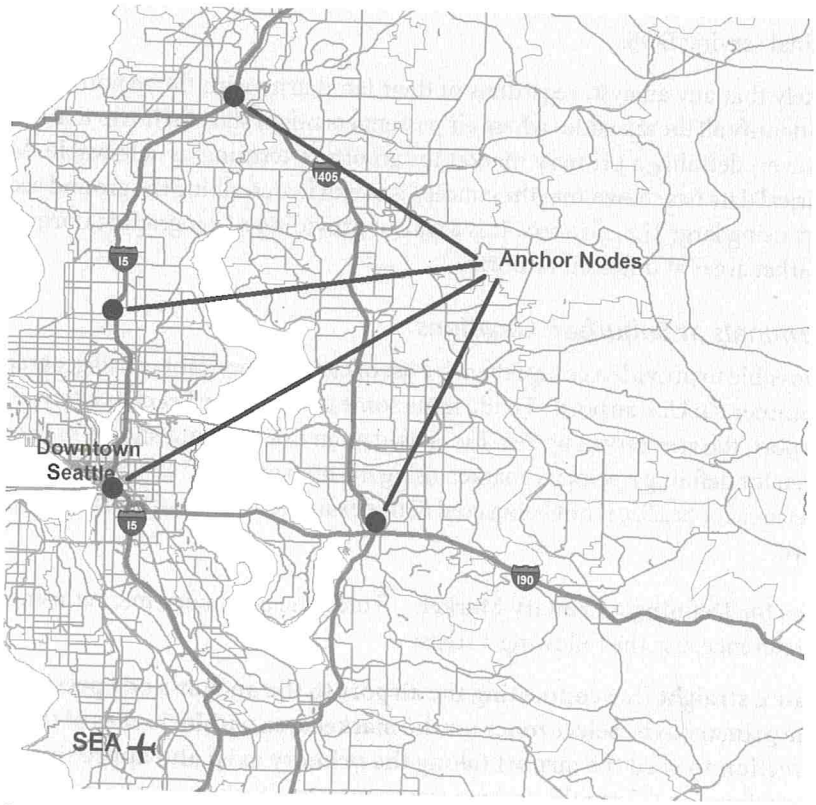
Selecting an Anchor Node and Zone for the Market Analysis

The anchor node is used to represent the location for an offsite terminal and serves as the focal point of the analysis. It is then referenced by the zip code zone in which it is found. If the anchor node is on the boundary of two or more zones, select the smallest or closest zone to the anchor node. Generally there are two types of locations to consider when applying the guidelines outlined in the previous section:

1. At an important junction of two highways, the anchor node/zone is the one where the two roads intersect.
2. Along a major airport access route without an intersecting highway. In this case, once the general area for an anchor node has been identified, one zone is selected because it has a higher concentration of airport trips than surrounding zones or it has some regionally significant attraction.

The map of the Seattle region in Figure 1 illustrates the selection of anchor nodes for Seattle-Tacoma International Airport (Sea-Tac). This example does not cover the entire Seattle region where additional anchor nodes may be found.

Not all guidelines can be followed when selecting a particular location. The analyst will need to use good judgment when applying the guidelines, taking into account the geography of the region, the roadway network, and the airport under consideration. Once a zone representing each anchor node has been selected, it should be highlighted on the regional base map for use in the next step.



Source: MarketSense Consulting

Figure 1. Seattle-Tacoma International Airport anchor nodes.

Step 2: Delineate Primary Market Area and Estimate the Number of Resident Air Passengers in the Primary Market Area

In this step of the analysis, the market area associated with the anchor zone is identified. The analyst builds the market area based on the anchor zone(s) from the first step and selects zip code zones or partial zones to include in the market area. The results of this step should be reviewed by someone familiar with regional travel routes to the airport. This is necessary to ensure the market area includes only those zones where it is reasonable to assume a traveler would find the anchor zone a reasonable stop on the way to the airport.

The concept of a primary market area is used in this analysis. The number of air passengers in the primary market area is one of the critical factors to consider when evaluating the development of an offsite terminal at a specific location. Defining a primary market area requires a map or GIS software. This provides the analyst with a visualization of the regional roadway network, intermodal centers and stations, and the local street network superimposed on the boundaries of the zip code zones. The shape of a primary market area will vary considerably depending upon the configuration of the roadway network.

Definition of Primary Market Area

A primary market area refers to a geographic area encompassing the origin zones (starting points) for customer trips to the airport. It is an area responsible for 70% to 85% of all customers attracted to a specific location. The remaining 15% to 30% of customers come from a much larger geographic area called the "secondary market." In the context of offsite terminals, a primary market is the geographic area from which the majority of offsite terminal customers begin their ground access trip to the airport. It is the logical core area that can be served by the offsite terminal and does not include fringe areas where there is less certainty of a customer base. Figure 2 illustrates the geographic relationship between the primary and secondary market area for an offsite terminal serving BOS.

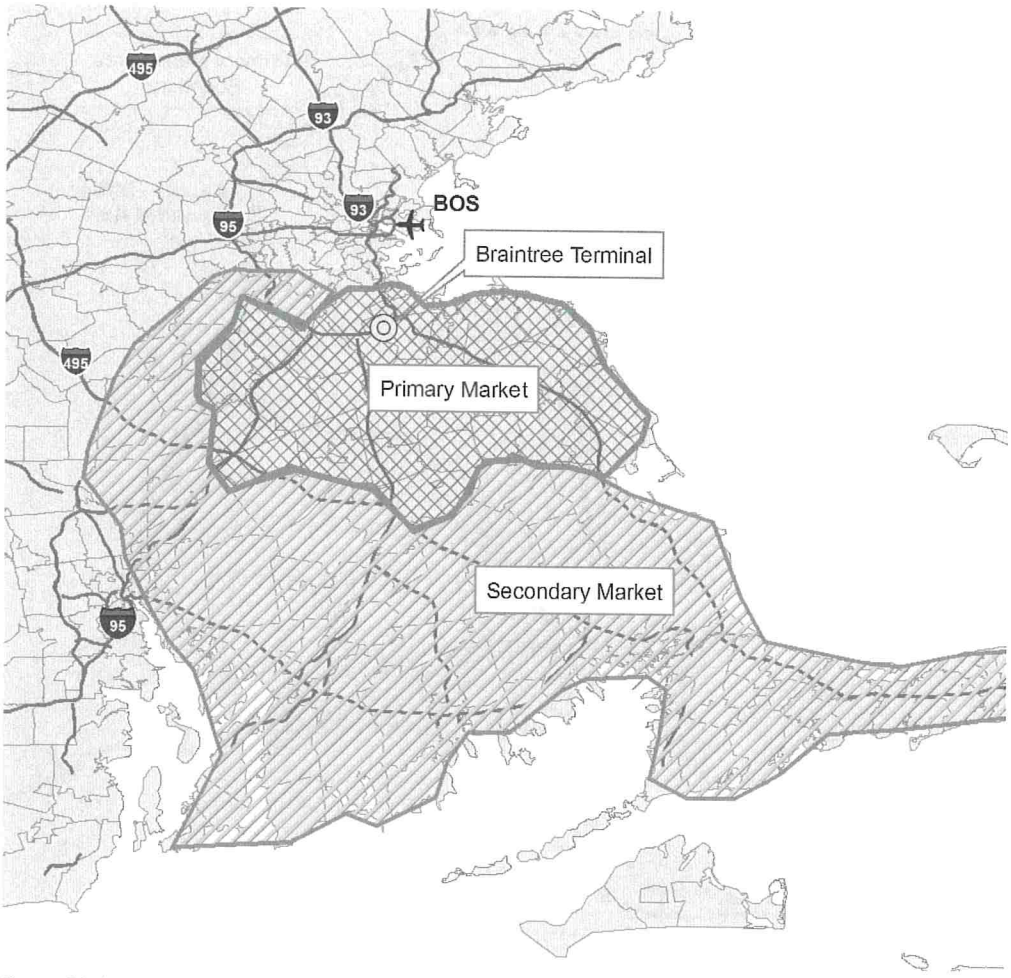
It is unlikely that any analyst, regardless of their familiarity with the region under consideration, could identify all the zip codes where air passengers might start their trip to a new offsite terminal. However, defining a primary market for an offsite terminal is achievable. More importantly, empirical data has shown that the concept is useful in describing the ground access patterns of customers using large U.S. airports. It is a way of providing a "geographic normalization" for studying market areas at different airports.

Offsite Terminals at Suburban Locations

It is not possible to provide a comprehensive list of criteria applicable to all geographic regions served by commercial U.S. airports. To illustrate some primary market characteristics applied to an actual airport, the area served by Sea-Tac is used as an example and shown in Figure 3. Directions are given for defining a primary market, using the map of Seattle as a reference. Note that the entire market area for SeaTac is not being used in this example, only a portion to the north and east of the airport.

Directions for Defining a Primary Market. To define a primary market using the map of Seattle as a reference, use the following 3 steps:

- **First, draw a straight line connecting the airport to the anchor node previously selected. This is the primary axis. Select zones for the market area within 5 miles of the anchor zone in the direction toward the airport (along the primary axis) and approximately 20 miles from the anchor zone along the major access routes in the direction away from the airport.** Air passengers will not travel backward, in the opposite direction from the airport, for more than a few miles. This is verified by reviewing the market areas for existing offsite terminals.

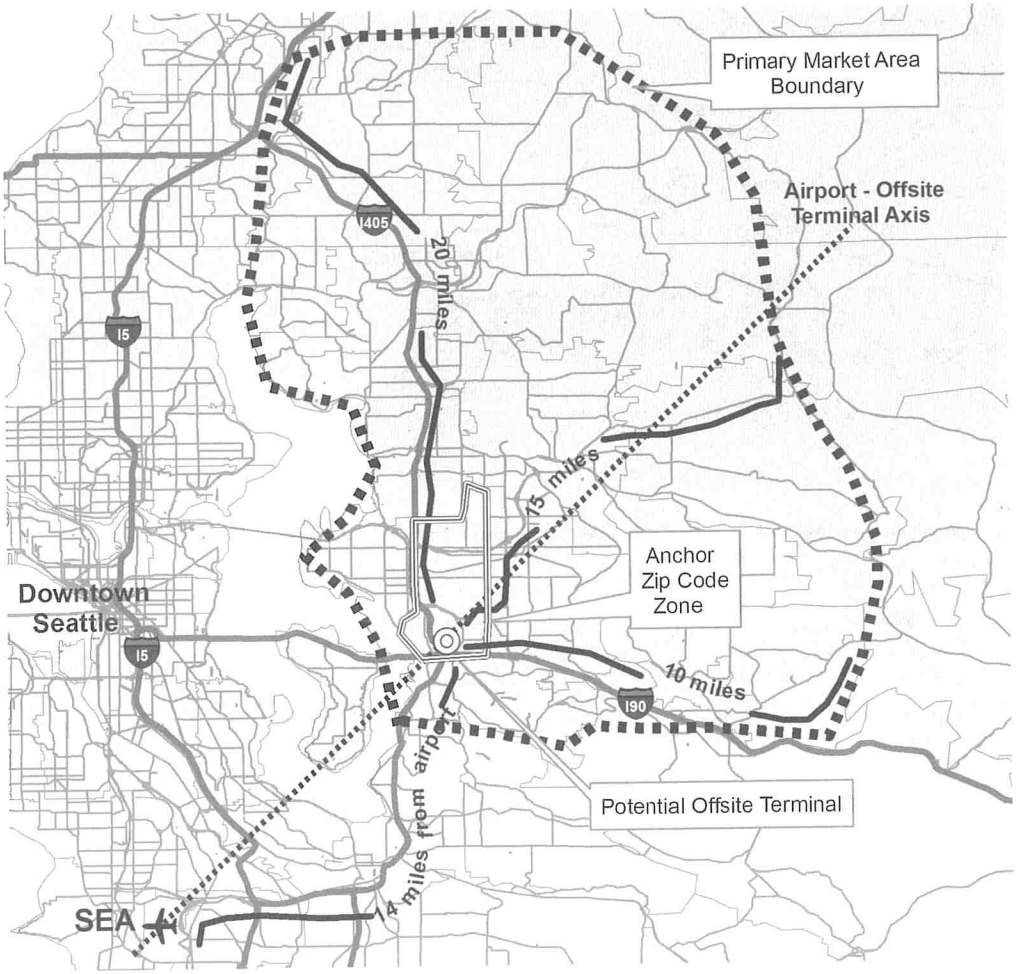


Source: MarketSense Consulting

Figure 2. Primary and secondary market area for Braintree terminal.

The distance air passengers will travel to the offsite terminal (in the primary market area) is not more than 30 miles based on empirical evidence. Air passengers will, however, travel much greater distances from areas in the secondary market area.

- **Next, on a second axis that is oriented 90 degrees to the primary axis, select zones up to 10 miles away.** The selected location must fall along the typical travel path from the zip code to the airport. If a zip code is large or encompasses an area that is only partially convenient to the selected location, the analyst can overlay a detailed street network. This will indicate the more developed areas and help the analyst estimate what proportion of the zip code would access the offsite terminal location. In the Seattle example, zones along I-90 are selected up to 10 miles away. Zones further than this distance have alternative access routes to the airport and are not part of the primary market area.
- **Finally, include zones or portions of zones in the primary market area if travelers would pass by or through the anchor zone on their trip to the airport.** The size of primary market areas is variable but usually falls between 200 and 600 square miles. In larger zones, where part of the zone is beyond the primary market, review the local street network to estimate the residential development that is within the primary market. Assume the air passenger trips within the primary market are directly proportional to the residential street network within the zone under review.



Source: MarketSense Consulting

Figure 3. Seattle-Tacoma International Airport—primary market.

After selecting the zip code zones to be included in the primary market area, the number of resident air passengers and the land area of each zone are compiled in a table such as the one shown in Table 2. Table 2 illustrates the critical data needed for this step of the analysis: the selected zip code zones, the land area of each zone, and the percent of the zip code zone within the primary market area. If airport employee and non-resident air passenger data is available by zip code, it should be added to the table by zip code zone.

Offsite Terminals at Downtown Transit/Rail/Intermodal Centers

The guidelines for determining the primary market for an offsite terminal at a downtown intermodal center are more general because of the lack of information about this emerging type of offsite terminal. Similar principles of access and location apply, but because the principal access to the terminal uses a transportation network composed of intermittent stops along fixed routes all converging at a downtown intermodal center, the primary market area is determined differently. It consists of a series of small areas around the access points to the transportation system and the immediate area around the downtown intermodal center.

Access to the transit network at each supporting station must be examined to determine whether it is logical for air passengers to reach the airport by first traveling via transit or rail to the downtown offsite terminal and then transferring to the airport transportation link. The via-

Table 2. Offsite terminal primary market area calculation.

	1	*2*	*3*	*4*	*5*	*6*
	Zip code	Zip code area (square miles)	2006 AADE resident air passengers	Percent of zip code zone in primary market area	2006 AADE resident air passengers in primary market area (col. 3 x col. 4)	Area (sq. mi.) of zone in primary market area (col. 2 x col.4)
Anchor zone	98005	7.76	72	100%	72	7.76
Zones in primary market area	98004	6.67	151	100%	151	6.67
Primary Market					**223**	**14.43**
					Total AADE Resident Air Passengers	**Total Square Miles**

Source: MarketSense Consulting

bility of a downtown intermodal location is determined by the geographic relationship of the airport, the intermodal station, and the start of air passenger trips to the airport.

Step 3: Compare Analysis Results to Offsite Terminal Primary Market Area Benchmarks

The research conducted for ACRP Project 10-02 used market data from existing offsite terminals in suburban locations at LAX and BOS to develop the analysis procedure that was then tested at four additional airports. The results for each test case airport market analysis were then verified and discussed with the respective airport operator. Table 3 provides primary market benchmarks developed from the offsite terminal analysis conducted for the six airports.

The majority of examples in Table 3 are suburban offsite terminals. There are two downtown intermodal terminals included in the table, Union Station in downtown Los Angeles and a test case scenario in downtown Houston (there are proposals to transform Union Station in downtown Houston into a multimodal transportation center). Nine out of the sixteen suburban examples have average densities of 4.0 to 5.0 resident air passengers per square mile in their respective primary market areas. The two downtown examples have densities much higher than those of the suburban examples as well as significant numbers of non-resident air passengers.

Although there is considerable variation in the primary market areas for the six airports, there are some thresholds that apply. Only one airport has a primary market area with less than 1,200 AADE resident air passengers. All the other airports have resident air passengers above this threshold in their primary market. All but one of the examples has a primary market between 200 and 600 square miles, and the distance from the airport for all examples is between 14 and 35 miles, including the downtown intermodal examples.

Step 4: Estimate the Number of Air Passengers in the Total Market Area

The total air passenger market can be estimated using empirical data about the proportional relationship between primary and total market areas of existing suburban offsite terminals. Resident air passengers account for 80% to 85% of all air passengers originating in the primary market area and subsequently using the connecting transportation link between the offsite terminal

Table 3. Offsite terminals primary market area benchmarks.

	Existing			Test Cases				
	Suburban		Down - town	Suburban				Down-town
Offsite Terminal	LAX Van Nuys	BOS 4 sites	LAX Union Station	DIA 3 sites	IAH 2 sites	PHX 3 sites	SEA 3 sites	IAH Union Station
Offsite terminal or anchor zone distance from airport (miles)	24	14–20	20	25–35	15–30	15	15–20	20
Primary market area size (square miles)	450	310–550	250	300–700	240–275	275–600	200–460	25
AADE resident air passengers	2,300	1,400–2,160	4,260	1,730–2,190	1,120–1,220	1,440–1,940	1,260–2,900	1,300
AADE resident air passengers per sq. mi.	5.1	4.0–5.0	17.0	2.5–7.0	4.0–5.0	2.4–7.0	2.7–12.0	50.0
AADE non–resident air passengers	850	980	3,790	NA	400–500	NA	1,100–1,900	2,530

Source: MarketSense Consulting based on air passenger survey data from LAX, BOS, DIA, IAH, PHX, and SEA.

and the airport. In addition, empirical data indicates that the number of air passengers in the primary market represents approximately 80% of the air passengers in the total market area. The ratio of primary market to total market is typically 80%; however, there can be market configurations where the distribution of an airport's customers results in a somewhat different ratio of as low as 70% or as high as 85%.

The total air passenger market for an offsite terminal can be estimated by factoring resident air passengers to total air passengers in the primary market and then factoring the primary market up to the total market. First, AADE resident air passengers are divided by 0.8 or .85 to estimate total air passengers (residents and non-residents) in the primary market. Next, air passengers in the primary market are divided by 0.8 to estimate the total air passenger market for an offsite terminal. These ratios do not apply to downtown offsite terminals because of the different configuration of their markets. No rules of thumb are available for downtown terminals, but Step 2 described some general guidelines for estimating the passenger base according to the number and type of intermodal linkages to the terminal.

Offsite Terminal Market Share

There are only a few examples of offsite terminals in operation today (Los Angeles International and Logan International Airports) where the airport operator sponsors the offsite terminals. Each conducts customer surveys and also maintains counts by ridership category for the transportation link. In addition, these airports conduct large-scale surveys of air passengers on a regular basis. Using the three sources of information it is possible to estimate the air passenger market share for the offsite terminals. In the primary market, the proportion of resident travelers using the offsite terminals ranges from 15% to 30% and the proportion of non-resident travelers ranges from 5% to 15%. The market share estimates from the Boston and Los Angeles regions can be used to estimate market share for new services.

Other Considerations

Moving Away from the Optimal Location

The analysis, up to this point, has dealt with hypothetical locations for offsite terminals without regard to the reality of the real estate landscape. Although an ideal location for a suburban offsite terminal may have been identified through the analysis, there may not be an available site or facility at the ideal location. For developing an offsite terminal, the objective then becomes one of finding an affordable site that is close to the optimal location.

Once a potential site is identified, its characteristics must be compared with the location criteria stated previously. Should one or more location criteria not be met, a determination must be made about how much the characteristics of the potential site deviate from the optimal and the likely impact on ridership. A case in point is the Peabody offsite terminal serving Boston Logan International Airport. While the resident air passenger market base is in line with other offsite terminal market areas, the poor access (only in one direction) and the location of the site on a secondary road have resulted in minimal use of the facility.

During this process, the project sponsor will also determine whether the properties under consideration meet the minimum parcel size requirement as well as any timing requirements due to site preparation, permitting, and rezoning requirements. The minimum parcel size is discussed further in the next chapter.

Existing Operators

Once the market analysis is complete and offsite terminal locations are identified, it is important to research the availability of privately operated bus service to the airport with and without offsite terminals. In some cases, there may be existing private operators providing airport access service from one or more of the potential offsite terminal locations or providing service to a portion of the potential market area. The operation and performance of these services should be incorporated into the analysis to determine the true market potential of the offsite terminal and transportation link under consideration. If the goal of the project sponsor is to serve unmet HOV demand to the airport, the project sponsor must determine if it makes more sense to provide an offsite terminal and transportation link in a primary market area that is not served by an airport transportation link or in an area that is underserved by a private-sector service. In an underserved area, it may be more cost effective for the project sponsor to collaborate with the private operator on ways to improve its market share instead of introducing a new or competitive service.

Checklist for Offsite Terminal Market Analysis

The offsite terminal/transportation link will only be successful if it serves a sufficient number of customers, based on the goals defined by the project sponsor. This requires placement in an area that will serve as a collection point for a large number of airport customers with a propensity to use such a service. The trip origins of airport users in relation to the location being considered for the offsite terminal and air passenger demographics are the primary determinants of this decision.

There are four steps in this analysis:

1. Review the regional roadway network and transit network in the region and select a starting zone for the market analysis,
2. Delineate the primary market,
3. Estimate the number of resident air passengers in the primary market area, and
4. Compare analysis results with market area benchmarks for offsite terminals.

Step 1: Review the Regional Roadway and Transit Network in the Region and Select an Anchor Node and Zone for the Market Analysis

Use the following guidelines when selecting an anchor zone:

- Distance of at least 10 to 15 miles from the airport;
- In one of the major highway corridors to the airport;
- Intersection of two major highways (particularly the intersection of radial and circumferential routes) or a zone on a major highway having a higher concentration of airport trips than surrounding zones;
- Proximity to major intermodal centers or regional shopping malls or other major activity center; and
- Locate where roadway congestion increases in the direction of the airport.

Step 2: Delineate Primary Market Area and Estimate the Number of Resident Air Passengers in the Primary Market Area

Develop estimates of AADE resident air passengers by zip code, prepare a regional base map, and select zones in the primary market area using the following guidelines:

- Select zones within 5 miles of the anchor zone in the direction toward the airport (along the primary axis); in the direction away from the airport, select zones up to 20 miles away from the anchor zone.
- On a second axis, oriented 90 degrees to the primary axis, select zones up to 10 miles from the anchor zone. Consider the roadway network and be aware of the typical travel paths air passengers would take from the selected zone to the airport.
- Include zones or portions of zones in the primary market areas if travelers would pass by or through the anchor zone on their trip to the airport. The size of a primary market area is variable but usually falls between 200 and 600 square miles (with the exception of a downtown offsite terminal).
- For larger zones, portions of which are beyond the primary market, review the local street network to estimate the proportion of the zone's street network within the primary market. Assume the air passenger trips within the primary market are directly proportional to the residential street network within the zone under review.

Step 3: Estimate the Number of Air Passengers in the Total Market Area

The estimation of the market-area passengers is as follows:

- Total resident air passenger market = AADE resident air passengers / 0.8; and
- Total air passenger market = total resident air passenger / 0.8 or 0.85.

Step 4: Compare Analysis Results with Offsite Terminal Primary Market Area Benchmarks

To compare analysis results with benchmarks, undertake the following tasks:

- Determine the number of AADE resident air passengers in the primary market area;
- Calculate the resident air passengers per square mile; and
- Compare the results of the analysis with the benchmarks found in Table 3 and use a minimum 1,200 AADE resident air passengers (approximately 900,000 annual resident air passengers) as a primary market area supportive of an offsite terminal based on existing empirical data.

CHAPTER 4

Project Definition and Planning

An offsite terminal is located in an area that is remote from the airport and serves its market area with a transportation link that provides service to and from the airport terminal area. The offsite terminal should offer an enclosed waiting area for its customers and sufficient secure parking. This chapter presents considerations and rules of thumb for the planning and development of the transportation link, parking, and the offsite terminal. Also discussed are guidelines for estimating the minimum parcel size for the offsite terminal. Site characteristics were discussed in Chapter 3. This chapter begins by discussing additional considerations in the site selection process.

Site Selection Process

Chapter 3 shows how to conduct a market analysis for an offsite terminal. Various site characteristics important to the success of an offsite terminal are presented as part of this analysis. Some of these characteristics are proximity of the offsite terminal to highway on- and off-ramps and the location of the offsite terminal in relation to the traveler's customary travel path to the airport.

Site availability, cost, and the time to prepare a site will ultimately determine where the offsite terminal will be located or whether it makes sense to open an offsite terminal at a particular time in the market area under consideration. Finding an appropriate site can be a difficult and time-consuming task.

Location

Site location is crucial to the success of the offsite terminal and transportation link. The offsite terminal must be located in an area not considered out of the way by the customer relative to their typical route to the airport. The offsite terminal must be far enough from the airport, relative to the distance already traveled, for the customer to consider stopping rather than continuing on to the airport.

In addition, the site of the offsite terminal and the surrounding area must be considered secure and safe; otherwise, the customer will not use the facility and will choose to travel directly to the airport.

Minimum Parcel Size

The minimum parcel size can be estimated by developing layouts that include the offsite terminal, air passenger and employee parking, private and commercial vehicle circulation, loading and unloading areas for the airport transportation link and intermodal connections, and commercial

vehicle layover areas. Considerations for estimating the terminal size and sizing the parking inventory are provided in this chapter. For an offsite terminal with minimal intermodal connections, automobile parking will account for a large proportion of the land area required.

To add some flexibility to what properties might be available for the offsite terminal, the project sponsor may define a minimum parcel size for surface parking and a minimum parcel size for structured parking, if the provision of structured parking is an option for the project sponsor.

Site Availability

Once the minimum parcel size for the offsite terminal has been determined based on near-term and long-term space needs, the project sponsor will begin the search for a viable site that meets size, location, and cost criteria, unless the site for the offsite terminal has been predetermined. Furthermore, the political environment must be favorable for introducing the offsite terminal in the area being considered, including public sentiment and reception by local officials. There is the possibility the public will be concerned about potential negative impacts generated by the offsite terminal such as additional vehicle trips generated in the areas surrounding the offsite terminal. Properties under consideration may also need to be rezoned for the intended use.

A property under consideration must be available for lease or sale by an owner who is willing to work with the project sponsor. A parcel requiring extensive site preparation or mitigation will add cost to the project and time to the schedule for opening the offsite terminal. Examples of potential mitigation include cleaning up hazardous materials and providing solutions for maintaining or improving traffic flow at surrounding intersections.

The project sponsor must decide whether it prefers to buy or lease the property for the offsite terminal. This decision may be driven by cost and policies of the sponsoring organization regarding the purchase or lease of off-airport property. A long-term lease (minimum of 20 years) could be structured with purchase and early termination options. This arrangement may be optimal for testing the market for the offsite terminal. Shorter-term leases may result in renewal rates that are unfavorable to the project sponsor, with the alternative of relocation undesirable and perhaps impossible based on land availability, location criteria, and the political climate. In the search for a site, the sponsoring organization may not find the "ideal" site and will have to make tradeoffs in selecting the site such as

- Selecting a site that doesn't meet all of the location criteria,
- Sharing the property with another use,
- Establishing the offsite terminal in another market area, or
- Waiting until a site becomes available in the optimal part of the market area.

If the sponsoring organization decides to locate the offsite terminal on a property with other uses, the offsite terminal and transportation link should have a clear identity and be easy for customers to find and use. Dedicated parking should be provided and the airport transportation link should have a dedicated boarding and alighting area. It is recommended that customers are provided with a dedicated waiting area.

Cost

For each parcel being considered, there will be a cost for acquisition or leasing, site preparation, design, construction, potential environmental studies such as an environmental impact report, and other studies and mitigation. There may be operating costs that are unique to some properties. When considering an individual property or comparing properties, it is important to identify and estimate all costs. Chapter 5, Costs and Benefits, provides information on cost categories.

Timing and Complexity

There are several factors for the project sponsor to consider related to timing and complexity when considering a property for an offsite terminal or when comparing properties. This includes when the property will become available and the time it will take to conduct environmental studies, obtain permits, prepare the site, construct the terminal, and get approval for any zoning changes.

Transportation Link

To encourage airport users to shift from on-demand, low-occupancy modes to using the offsite terminal, the transportation link should be tailored to the needs of airport users. Although the most flexible and cost-effective high-occupancy transportation link between the offsite terminal and the airport will be a bus, most of the information provided in this section also applies to a rail link. The project sponsor might consider testing the market for an offsite terminal with a bus link before it commits the time and funds to developing a rail link. If the market is not responsive to the offsite terminal, a different market location could be tested.

The transportation link between the offsite terminal and the airport must provide service that is competitive with the alternative modes available to the airport user, with door to door travel time being an important consideration for the time-sensitive customer. Airport users will compare the total travel time for using the offsite terminal and transportation link to the time it takes using their preferred mode of airport access.

In addition to service characteristics related to travel time, there are other considerations in planning and developing a transportation link that will influence project cost, customer use, and customer service. These are shown in Table 4.

Table 4. Relationship between the transportation link and cost, ridership, and customer service.

Element/Influence	Cost	Ridership	Customer Service
Hours of Operation	√	√	√
Service Frequency	√	√	√
Number of Stops	√	√	√
On-time Schedule		√	√
Luggage Storage	√	√	√
Amenities	√		√
Revenue Collection	√		√
Operated by Project Sponsor or Third Party	√		
Vehicle Ownership	√		
Vehicle Type	√		

Source: DMR Consulting

Hours of Operation

It is critical to analyze the overall flight schedule, as well as the distribution of international and domestic seats, when developing hours of operation for the transportation link considering lead time for the first departing flight, lag time for checked luggage on the last arriving flight, and potential delays. Since most airlines recommend that passengers arrive at least 90 to120 minutes before flight departure for domestic flights and longer for international flights, for a bus service to accommodate the full departures schedule, the first scheduled bus should be timed to depart from the offsite terminal so it arrives at the airport at least 90 to120 minutes before the first scheduled flight. Similarly, if the transportation link is to accommodate the full arrivals schedule, it should be in operation until at least 1 hour past the last scheduled flight arrival at the airport. If the project sponsor also wants to serve the full airport employee schedule, service may have to be expanded further. If the airport experiences frequent delays in flight departures or arrivals, the project sponsor should also consider offering extended hours to accommodate those delays or provide alternative transportation (i.e., a guaranteed ride home) for delayed passengers using the offsite terminal and transportation link.

Even at very busy airports, there is typically a time in the late evening/early morning when the number of departing or arriving flights is low or has ceased operation in one direction while there is still significant activity in the opposite direction, taking into account lead and lag times for the offsite terminal. Provision of scheduled bus service in one direction doesn't reduce costs significantly since the bus must still travel in the opposite direction. Through analysis of the flight schedule, the project sponsor can determine what percentage of departing and arriving seats would be served if the transportation link hours of operation accommodated less than 100% of the flight schedule and then decide whether the cost savings outweigh the loss of potential customers not served by the transportation link. For example, can a schedule be developed that accommodates 90% of scheduled seats considering lead and lag times? What is the cost savings compared with providing a schedule that accommodates 100% of scheduled seats? If there are airport employees in the market area of the offsite terminal, how might they be impacted by the reduced schedule?

If an airport user perceives that the transportation link is available for limited hours, that customer may not use it for all trips to the airport because it wasn't available for one trip. In addition, an airport user requiring flexibility, particularly the business traveler, will not want to be constrained by the operating hours of the transportation link. Hence, the lower the percentage of the flight schedule served by the transportation link, the less desirable it will be to airport users in its market area. A bus schedule that accommodates 70% of scheduled seats will be less appealing to travelers in the market area than a schedule that accommodates 90% of seats.

The recommended approach for developing the hours of service is for the first bus departing the offsite terminal to serve the first significant bank of departing flights and then to develop the rest of the schedule based on this. If there are a significant number of arriving seats prior to this time, the schedule would begin from the airport to the offsite terminal to accommodate these passengers. The ending hours will depend on the amount of arriving and departing seats in the evening.

If the project sponsor is considering more than one option for the provision of service hours, it should consider that it is more difficult for customers to accept cuts in service compared with additions in service. Service hours that accommodate less than 80% of departing seats or 80% of arriving seats are not recommended, neither is a schedule that doesn't accommodate a significant number of departures or arrivals in a concentrated time period. Once the service is in operation, the project sponsor should monitor changes in air travel patterns and customer comments to determine whether adjustments in the schedule are necessary.

Number of Stops

Ideally, the transportation link will provide nonstop service between the offsite terminal and the airport to minimize travel time. Under some circumstances, one stop may be acceptable if the increase in overall trip time is insignificant compared with total travel time:

- **For distances less than 25 or 30 miles from the airport,** a nonstop bus service is recommended between the offsite terminal and the airport.
- **For offsite terminals that are more than 25 or 30 miles away from the airport,** an interim stop may be acceptable if it is close to the highway and the stop does not add more than 5 or 10 minutes to the overall travel time. An interim stop meeting these criteria may make the service feasible if one or both of the market areas cannot support a dedicated bus service individually.

Example of Transportation Link between Airport and Offsite Terminals: LAX's FlyAway

Los Angeles World Airports, owner and operator of LAX, operates LAX FlyAway, three nonstop buses to LAX. Two operate from an offsite terminal and initially offered long-term parking and remote luggage check-in for domestic flights only; however, LAWA discontinued remote luggage check at all FlyAway locations in 2008 because of low customer usage. The third operates from a dedicated bus stop and offers remote luggage check-in and short-term parking only.

LAX's FlyAway: Three Nonstop Buses

	Van Nuys	Union Station	Westwood
Distance from LAX (miles)	24	20	10
Hours of operation	24 hours	24 hours	5 A.M.–1 A.M.
% of enplaning seats served*	100%	100%	89%
% of deplaning seats served[1]	100%	100%	99%
Headways to LAX	15 minutes: 4:45 A.M.–9:30 A.M. Half hourly: 3 A.M.–4:30 A.M.; 10 A.M.–midnight Hourly: 1 A.M.–3 A.M.	Half hourly: 5 A.M.–1 A.M. Hourly: 2 A.M.–4 A.M.	Half hourly: 5 A.M.–1 A.M.
Headways from LAX	Half hourly: 5:30 A.M.–midnight 8 trips between midnight and 4:45 A.M., varying headways	Half hourly: 5 A.M.–1 A.M. Hourly: 2 A.M.–4 A.M.	Half hourly: 5 A.M.–1 A.M.
Stops between offsite terminal and LAX	0	0	0

*Based on May 2007 flight schedule.

Service Frequency

The transportation link should provide frequent service to the airport. Long wait times add to passenger concern about getting to the airport on time and leave a negative impression for future use. The longer the distance and travel time to the airport, the more willing an air passenger will be to allow more lead time to get to the airport:

- **For offsite terminals that are located from 10 to 25 or 30 miles from the airport**, the bus should provide service at a minimum of every 30 minutes during most of its operating hours. Departures from the airport should run at the same frequency for consistency. Service should be added during busy periods. During slow periods, hourly service may be acceptable to customers.
- **For offsite terminals that are more than 25 or 30 miles away from the airport,** hourly service may be acceptable to customers. Service should be added during busy periods.
- **Offsite terminals in the United States are not located less than 10 miles from the airport.** If the project sponsor is considering development of an offsite terminal at a location closer than 10 miles from the airport, it should consider the proximity of the site to remote airport parking facilities. If the site is perceived to be close to a remote airport parking facility, the frequency of the transportation link should be at least as good as frequencies provided by the shuttle service at the remote airport parking lot.

On-Time Schedule

Customers must be certain that the transportation link is reliable or they will not use it. The service must be scheduled so that all buses depart on time with no dropped or missed trips. An adequate number of seats should be offered to accommodate demand, and passengers should be assured of a seat with extra buses made available during peak travel times. Passengers should be made aware of average and peak travel times with advisories provided to them regarding delays or changes to the operation, especially during peak travel periods.

Luggage Storage

The vehicle selected for the service should accommodate the needs of the airport customer, many of whom have heavy luggage or multiple pieces of luggage. Ideally the vehicle will have a secure luggage hold area (e.g., an underfloor baggage-storage area) with luggage returned to passengers at the end of the trip. Luggage storage in a contained area inside the bus or sufficient space surrounding individual seating may also be acceptable. A passenger who experiences crowding in a vehicle due to insufficient luggage storage may be discouraged from using the transportation link in the future.

Amenities

The project sponsor should consider the customer types using the service and determine whether there are amenities that can be offered in the vehicle that may promote a positive customer experience and encourage repeat business, for example, wireless internet for longer trips or perks similar to the in-flight experience such as music channels or video programming using headsets, blankets, and bottles of water. Although amenities on the transportation link will improve the customer service experience, there is no evidence such offerings will increase ridership.

Revenue Collection

Revenue collection will impact both cost and customer service. Options for revenue collection include onboard fare boxes, automated ticketing machines/kiosks at the airport and the offsite

terminal, tickets sales by the bus driver or personnel at the offsite terminal and/or the airport terminals, and internet sales. It may also be beneficial to coordinate with local transportation agencies for acceptance of local transit passes, transit proximity cards, or a debit/credit system associated with toll roads and bridges.

Operated by Project Sponsor or Third Party

Another important consideration is whether the bus service will be operated by the project sponsor or contracted out to a third party with experience operating a bus service. Factors that will influence the decision to use one model over the other include cost of providing the service, quality of service, liability, and policies and regulations within the sponsoring organization such as labor rules and procurement requirements. Another consideration is the cost and risk associated with early termination of the bus service.

There are two models for operation by a third party, with the primary differences being the level of control over the transportation link by the project sponsor and which party assumes financial responsibility:

1. **Management Contract**—through a competitive bid or proposal process, the sponsoring organization retains a third party who will operate the service on behalf of the sponsoring organization. The sponsoring organization determines the service characteristics of the transportation link and provides specifications for the vehicle type. The third party operator is paid a fixed amount of money by service unit provided (e.g., rate per bus hour or bus mile). The sponsoring organization is financially responsible for an operating deficit or retains operating income. The operator is responsible for all aspects of operating the buses. As noted below, the sponsoring agency may or may not provide and maintain the buses.
2. **Concession Agreement**—the sponsoring organization awards a concession agreement to a third-party operator through a competitive bid or proposal process. The project sponsor is typically not financially responsible for the service and may receive revenue for granting the right to operate the service. The sponsoring organization may specify some service parameters, but it will typically have less control over service characteristics than if it was financially responsible. If the service is put out for third-party operation or concession, some items to consider when developing solicitation documents and subsequent contracts include the following:
   - Service parameters: fare, level of service, and operating hours;
   - Length of contract;
   - Provisions for termination, cause, and no-fault: if buses are owned by a third-party operator, provision for buyout that is fair to both parties;
   - Customer-service standards;
   - Maintenance standards;
   - Maintenance plan;
   - Schedule adherence: rewards and penalties;
   - Fuel escalation provisions;
   - Reporting requirements;
   - Training;
   - Personnel standards;
   - Indemnification;
   - Insurance provisions;
   - Vehicle and fueling specifications:
     - Age, condition, passenger capacity, luggage capacity, size, height, fuel type, and ADA and
     - Amenities on the bus;
   - Schedule and staffing plan;
   - Terms of additional service: holiday periods, permanently extended service hours, and special events;

- Expectations regarding cleanliness of vehicles, drivers, and uniforms; and
- Contract monitoring and accountability.

Most of the items listed above will have to be identified and planned for if the transportation link is operated by the project sponsor.

Vehicle Ownership

Regardless of which of the three operational models is adopted—self-operation, a third-party bid, or a concession agreement—the sponsoring organization or a third party may own the vehicles (see Table 5). Whether it makes the most sense for the sponsoring organization to be responsible for the buses or for a third-party operator to provide buses depends on individual circumstances.

One of the potential cost disadvantages of using a third-party operator for provision of the bus service is that the length of the contract may typically be for 5 years or less due to procurement requirements of some sponsoring organizations and to allow for competition in the marketplace. Since buses are a major purchase and the cost of the buses is typically amortized over a period that is longer than the time period of the operating contract, the operator may pass on higher costs to the sponsoring organization to recoup the entire cost of the rolling stock during the contract period. This is one reason for the project sponsor to consider owning or leasing the buses for the transportation link. In return for taking on the risk of ownership, the project sponsor is able to pay the true cost for the vehicles over their expected life and the buses are available for use independent of the third-party operator. In this case, maintenance of buses can be provided by the sponsoring organization, the third-party operator, or a contractor.

Offsite Bus Link Example: Operation of the Logan Express

Massport, owner and operator of Boston Logan International Airport, operates four offsite terminals with nonstop express bus service—the Logan Express—to and from Logan Airport. The routes are operated by different third-party operators who were awarded the rights to operate the service on behalf of Massport through competitive bid. The buses are owned by the private operators. Massport is considering bus ownership in the future.

The project sponsor may mitigate the risk to the operator and lower its costs through development of business terms included in the request for proposal (RFP) and contract. For example, the Massachusetts Port Authority (Massport) provides an amortization table in its Logan Express contracts that shows how much Massport will purchase the buses for from the operator during the contract period if the contract is terminated early.

Table 5. Bus ownership options by operational model.

Operational Model/Vehicle Ownership	Sponsoring Organization Own/Lease	Bus Operator/ Concessionaire Own/Lease
Sponsoring Organization	√	
Third-Party Competitive Bid	√	√
Concession Agreement	√	√

Source: DMR Consulting

Another reason for the sponsoring organization to consider purchasing or leasing buses is it allows the sponsoring agency a greater ability to specify the type, model, and configuration of the vehicle. If more than one route is in operation and the routes are operated by different companies, there may be economies of scale in the system if the buses are provided by the sponsoring organization. In this case, fewer spare buses would be needed as backup for buses in regular service than if spare buses are provided by route.

Vehicle Type

The type of vehicle put in service will impact the cost of the transportation link and will also have environmental impacts. It may have an impact on curb management at the airport, depending on the size of the vehicle. ADA requirements will also influence vehicle selection.

The vehicle type may have an influence on ridership if the vehicle has the feel of public transportation rather than a service designed for airport users—that is, the perception of an uncomfortable, noisy city bus versus a smooth, comfortable ride. Coaches or vehicles with the comfort of coaches are recommended, with features such as cushioned seats, armrests, and tray tables, particularly for trips of long duration.

Capital, operating, and maintenance costs plus expected life cycle will impact the cost of providing the transportation link. Capacity will also impact cost if a smaller vehicle will require more buses to be put into service to meet demand. The project sponsor should consider what type of vehicle is most likely to attract the targeted customer groups.

If the sponsoring organization has environmental requirements or goals, they may influence selection of the vehicle type. If alternative-fuel vehicles are considered, the location of fueling facilities in the vicinity of the airport and the offsite terminal for regular fueling, as well as backup fueling facilities for emergency situations, should be identified in advance. Alternative-fuel vehicles available in the marketplace may dictate vehicle size or vehicle comfort.

The size of the bus in relation to airport terminal curb capacity and bus layover and overnight space should also be considered. If the bus is operated by a third-party operator, overnight storage may be provided by the third party operator.

Customer Parking

An air passenger who typically would drive to the airport and use long-term parking will consider using an offsite terminal and transportation link if the appeal of using the offsite terminal is close to that of driving directly to the airport. This means that the experience of getting to the terminal as well as use of the terminal must be easy and safe. As this relates to parking, the parking supply should be

- Dedicated for airport users,
- Adequate to serve demand, and
- Secure for its users.

If there are a significant number of airport employees using the offsite terminal, employee parking should not interfere with air passenger parking. Passenger parking should be located closer to the terminal. Elements of parking to be evaluated during project definition include

- Air passenger parking inventory:
  - Long-term spaces (vehicles parked for duration of air travel) and
  - Short-term spaces (serving passenger drop-off and pick-up);

- Airport employee parking inventory;
- Surface lot versus parking structure;
- Hours of operation;
- Revenue collection/parking technology; and
- Security.

Air Passenger Parking Inventory

Long-term Parking

The provision of a sufficient supply of long-term parking is crucial to attracting customers to the offsite terminal, particularly for offsite terminals located in suburban areas with little or no public transportation access. The provision of insufficient long-term parking to accommodate ridership will almost certainly result in ridership not reaching its potential, while the provision of parking in excess of demand does not guarantee additional revenue. A customer who travels to the offsite terminal and is turned away because there is no available parking must alter his or her plans and drive to the airport to make the flight. This inconvenient situation often results in a permanently lost customer who will most likely warn other people not to use the offsite terminal.

In some instances, it may be unrealistic for the project sponsor to provide parking for every customer due to cost or scarcity of land. In these cases, the project sponsor can manage the parking supply through pricing or information dissemination or can provide supplemental parking nearby (e.g., holiday overflow parking, as is done at many airports). Providing customers with information about limited parking availability allows them to make the decision in advance either to access the offsite terminal through a drop-off mode or to use a different transportation mode to the airport. In this case, the offsite terminal may not attract all of its potential customers, but it also will not alienate them.

For offsite terminals located in a densely populated area or in an area with high-quality, frequent, and reliable public transportation connections, long-term parking can be sized accordingly since passengers may access the offsite terminal by other modes in addition to private automobile. If the offsite terminal is located in a facility that is shared with other uses such as an intermodal transportation center, a sufficient amount of parking is still crucial. The best way to guarantee a sufficient parking supply for airport users is to provide dedicated parking or a designated area of a larger parking supply for offsite terminal customers.

Guidelines for Sizing Long-Term Parking Typically it takes 3 or 4 years for the airport transportation link to realize its full ridership potential, referred to as "mature ridership," as customers in the market become aware of the new service and shift from their previous modes of access to and from the airport to the offsite terminal and transportation link. Parking should be sized to accommodate demand for at least 4 years of growth after mature ridership. The project sponsor should develop a plan for future expansion of parking spaces that will not disrupt the existing parking supply.

Number of Spaces For a suburban terminal with few public transportation connections, most passengers will access the offsite terminal using a private automobile in which they are picked up or dropped off or they will use long-term parking. The long-term parking supply is used exclusively by resident air travelers since non-residents do not have a private automobile locally. Parking can be sized by analyzing the mode choices of resident passengers in the market area of the offsite terminal by travel purpose. In general, the ratio of resident passengers traveling directly to the airport using long-term parking to those using automobile pick-up/drop-off

also applies to use of the offsite terminal, considering travel party size and trip purpose. For example, if the mix of resident pleasure travelers using private automobiles is 25% long-term park and 75% pick-up/drop-off, this ratio will be about the same for resident pleasure travelers using the offsite terminal.

To size parking, travel party size and average trip length should be considered. Evaluating information on average length of stay in on-airport parking facilities (particularly for economy or remote lots) can help with this determination. Users of long-term parking at an offsite terminal typically have an average length of stay that is at least 1 day longer than the average length of stay for users of on-airport long-term parking since an offsite terminal is typically not attractive to travelers parking for 1 day (i.e., the business traveler). Comparison of occupancy data for off-peak, average, and peak travel times can also help with determining the amount of parking needed to accommodate demand during typical travel times versus busy times such as holidays and vacation periods.

If the offsite terminal will be served by frequent and convenient intermodal connections that allow airport passengers to connect to the airport transportation link in a timely fashion, the amount of long-term parking needed can be factored down to account for resident travelers projected to access to the terminal by other modes. For each viable connection, the project sponsor would estimate the number of resident air travelers in the market area who would use those connections to the offsite terminal instead of parking at the offsite terminal, then factor down the number of parking spaces needed considering party size and length of stay.

To illustrate, Table 6 provides information on the parking supply for the offsite terminals serving Boston Logan and Los Angeles International Airports. Since passenger characteristics vary by airport, this data may or may not be helpful in determining a parking estimate for an offsite terminal in a new market area. Analysis of specific data, using the guidelines in the previous section, is the most valid way to develop an estimate of the inventory needed.

Table 6. Characteristics of parking supply at existing U.S. offsite terminals.

Airport	LAX	BOS	BOS	BOS
Offsite terminal	Van Nuys FlyAway	Braintree Logan Express	Framingham Logan Express	Woburn Logan Express
Average daily enplaning passengers[1]	937	464	479	228
Average daily employees *to* airport[1]	165	267	82	167
Parking spaces	2,950	1,162	346	875
Dedicated employee spaces	No	800	290	No
Total spaces	2,950	1,962	636	875
Facility type	Structure	Surface	Surface	Surface
Constrained	No	No	Yes	No
Overflow parking	No	No	Yes	No
Terminal size (sq. ft.)	15,000	5,000	2,250	7,500

[1]Calendar Year 2006

Source: DMR Consulting based on data from LAWA and Massport.

Table 7. Land area needed for 1,000 parking spaces.

Area per Space (sq. ft.)	Land per 1,000 Spaces (sq. ft.)	Land per 1,000 Spaces (acres)
280	280,000	6.43
300	300,000	6.89
320	320,000	7.35
330	330,000	7.58
350	350,000	8.03
360	360,000	8.26

Source: Jacobs Consultancy.

Land Area Needed

Table 7 shows the land area needed for 1,000 parking spaces based on different unit space sizes. For a surface lot, the land area includes circulation space, entry/exit plazas, and some landscaping. Since more circulation space is needed for a parking structure for ramps, stairs, and elevators, higher unit space sizes in the table should be used for a parking structure. Typically the unit size per space is between 320 and 360 square feet. To develop initial estimates for the land area needed for the offsite terminal and parking, 350 square feet per space is a reasonable estimate, absent detailed plans.

Short-term Parking

Sufficient parking should be available near the offsite terminal for the loading and unloading of passengers being picked up and dropped off. It will be easier for both pick-up/drop-off passengers and long-term parkers if the two types of parking are segregated.

For passengers being dropped off, the amount of time the accompanying automobile will park will be equal to or less than the bus headway since the automobile will typically not remain at the offsite terminal once the air passenger has departed. Automobiles picking up passengers may wait a little longer since they may arrive further in advance of the bus. The number of short-term spaces required can be determined by calculating the ratio of resident pick-up/drop-off passengers to long-term parkers and travel party size, by considering parking needs for the next departing bus and the next arriving bus, and by making assumptions about dwell times. Non-resident passengers may also be picked up and dropped off by private automobile, and this should be factored into the short-term parking needs. In general, for a bus service with half-hourly headways and a capacity of 40 to 50 passengers per bus, a short-term parking area with 20 to 40 spaces should be sufficient to serve both average periods and peak periods. If the terminal offers amenities that are used by the meeter/greeters or the general public, the short-term parking supply should be adjusted accordingly.

Airport Employee Parking Inventory

The amount of parking needed for airport employees will be related to the number of airport employees residing in the market area, the hours of operation of the transportation link in comparison with employee work schedules, and where the bus picks up and drops off at the airport compared with where employees work. Other factors impacting the likelihood of employees to use the bus include cost and convenience. If a significant number of employees are projected to use the offsite terminal, employee parking should be segregated from air passenger parking, with spaces closest to the terminal reserved for air passenger parking.

Surface Lot Versus Parking Structure

The project sponsor will make the decision to provide surface or structured parking based on land availability, inventory, financial impacts, and customer-service considerations.

Land Availability

The size of available property that will be used for the offsite terminal compared with near-term, medium-term, and long-term parking projections may drive the decision to provide either surface or structured parking. Conversely, surface or structured parking preferences may be a criterion for selecting the site for the offsite terminal.

Parking Inventory

If the majority of the parking supply for air passengers will offer short walks to the terminal and the terminal is in sight of all parking spaces, a structure is probably not necessary. If more than 50% of the parking supply will require a walk of more than 600 feet, considering that some passengers will use the short-term parking area to drop off luggage in the terminal prior to parking in long-term parking, then shuttle buses around the surface lot or structure should be considered. A convenient drop-off area or the provision of luggage carts in the lot may mitigate the need for a shuttle bus or a parking structure.

Financial Impacts

Estimated costs and revenues will play an important role in determining what kind of parking facility to develop. A surface lot that can be operated without a shuttle bus to transport passengers between the lot and the offsite terminal will cost less to provide and operate than a parking structure. If a shuttle bus is being considered to shuttle customers between the surface lot and the offsite terminal, analysis will show whether the cost of a structure or a surface lot is more costly. Through analysis, the project sponsor can determine the daily parking rate that would be necessary for each parking facility type, given projected costs and revenues of other portions of the project and the overall financial goals of the project. Further analysis will show whether the market can bear the parking rates. Chapter 5 includes guidelines for estimating the capital costs of parking facilities.

Customer-Service Considerations

Walk times for customers between parking spaces and the offsite terminal are important to consider, as well as actual and perceived security of the parking facility types. Weather conditions in the airport market area may also play a role in the decision to provide structured parking if it will make a significant difference to the well-being of passengers or automobiles. There may be additional customer service considerations in a particular airport environment that will influence the parking facility type chosen.

Hours of Operation

At a minimum, the hours of operation of the parking facility should accommodate the schedule of the transportation link. In addition, there should be a way for customers to retrieve their automobiles outside of bus operating hours when, for example, a flight arrival is delayed and the last bus is missed.

Revenue Collection/Parking Technology

The best method and technology for parking revenue collection should be determined in advance by considering the facility, costs for equipment, operation and maintenance, and what kind of data will be needed for performance measurement.

Security

The location of the offsite terminal, including the parking area, should provide the customer with a sense of safety and security. The passenger must feel safe in the parking facility and should perceive that parking at the offsite terminal is as safe as parking at the airport. Layout lighting, fencing, and presence of staff or security patrol are all important considerations.

Offsite Terminal

The configuration of the offsite terminal and the level of amenities should be developed to satisfy near-term airport user needs and projected long-term needs. What is practical and feasible for a specific project will depend on budget and goals and objectives unique to the project sponsor. If possible, customers should feel that once they arrive at the offsite terminal the airport experience has begun and they no longer need to worry about getting to the airport. While the high-quality transportation link will ease the customer's concern about the trip to the airport, layout and amenities provided at the offsite terminal can serve as an extension of the on-airport experience.

The following project elements will impact the cost, design, and operation of the offsite terminal:

- Shared space versus dedicated terminal,
- Modular building versus permanent structure,
- Size,
- Basic customer conveniences provided in an offsite terminal,
- Amenities,
- Pedestrian and vehicular access and circulation,
- Bus bays and layover area,
- Security, and
- Hours of operation.

Shared Space Versus Dedicated Terminal

If possible, the offsite terminal should be a freestanding structure intended exclusively for airport users and should also incorporate the ambiance of an airport terminal. This is especially important in suburban locations, where airport users may not be as familiar or comfortable using bus or rail service as airport users living in urban locations.

Another option is to co-locate the offsite terminal with a well-utilized intermodal center serving a geographic area with a threshold number of air passenger origins, as described in Chapter 3, either by automobile access or through the use of high-quality intermodal connections. While this may detract from the desired airport experience, it may not have a negative impact on ridership and may boost ridership, particularly among non-resident air passengers. This depends on a number of factors, including the terminal layout, the location of the airport transportation link, the perceived level of safety of the terminal, the quality of the terminal, and the ability of the intermodal connections to provide frequent and reliable connections to the airport transportation link. The airport transportation component of the intermodal center must have a strong identity: airport users must be certain of how to find the boarding area for the airport transportation link in order to board the next departing trip. At a minimum, the project sponsor should provide a dedicated waiting area and/or a boarding/alighting area within the intermodal facility.

When a freestanding offsite terminal is not feasible or desirable because of costs, land availability, political considerations, or other reasons, it may be located within another activity cen-

ter such as a regional shopping center or office complex. In this case, the offsite terminal will function most effectively if it is situated independently of all other facilities so that airport users can easily locate it, do not have their access or egress impeded by non-airport users, and are not competing for parking with non-airport users.

Shared Terminal Example: LAX's Union Station FlyAway

Los Angeles World Airports operates the Union Station FlyAway, a nonstop bus service between Union Station in downtown Los Angeles and LAX. The service picks up and drops off airport customers at a bus plaza adjacent to Union Station. Union Station is an intermodal terminal serving Amtrak, commuter rail, light rail, and bus passengers. The terminal provides a waiting area, restrooms, food and beverage options, and a newsstand. FlyAway passengers purchase tickets at a dedicated kiosk on the bus plaza. (Until 2008, passengers had the option checking their luggage through to their final destination for domestic flights on most airlines; remote baggage check-in was discontinued in 2008 due to low customer usage.) For passengers accessing the FlyAway by private automobile, a dedicated parking area for FlyAway passengers is located in the parking garage adjacent to the bus plaza. Opened in early 2005, the Union Station FlyAway provided the missing link between LAX and the region via all modes serving Union Station.

Modular Building Versus Permanent Structure

If the project sponsor will be pursuing a dedicated terminal, a modular structure may be an option under the following circumstances:

- In place of a permanent structure to reduce capital costs,
- To test the market before a larger investment is made for a permanent structure, or
- To provide a waiting area while a permanent structure is being built.

The number of passengers the offsite terminal will accommodate and the amenities in the terminal may influence the decision between a modular and permanent facility.

Size

A permanent structure should be sized to accommodate passengers for medium-term growth (7 to 10 years) at a minimum and be designed to provide sufficient flexibility to accommodate long-term growth. It should have room for basic customer conveniences and amenities to be provided at the outset, as well as additional amenities that may be provided at a later date within the original footprint. For a shared terminal, consideration must be given to how customers will be provided with basic conveniences, and, if some of the conveniences aren't provided, how it might impact customer perception of the service and potential ridership.

Basic Customer Conveniences Provided in an Offsite Terminal

Basic customer conveniences provided in an offsite terminal include the following:

- Waiting area and seating with sufficient space for placement of luggage—seating needs can be estimated by considering capacity and schedule of buses traveling to and from the offsite terminal, plus estimated use by meeters/greeters and users of other services in the terminal;
- Adequate space for customer circulation with luggage;

- Restrooms;
- Space for bus ticketing—bus ticketing machines or customer ticket booth;
- Space for parking revenue collection—if the parking revenue system selected requires space in the terminal;
- Vending machines;
- ATM;
- Public telephone; and
- Courtesy phone for local taxicab service and/or local hotel/motels.

In addition, it may be required or desirable to have a separate restroom and break area for offsite terminal employees and bus drivers.

Amenities

An offsite terminal building that offers some of the features of an airline terminal provides an environment with a similar feel to the airline terminal. In addition to the basic customer conveniences in the offsite terminal—waiting area and seating, restrooms, space for bus ticketing, an ATM, and public telephones—the amenities discussed in this section will enhance the customer experience in the terminal, but should be weighed against the feasibility of providing them. There is no evidence that the amenities will attract additional customers.

Some amenities will not be economically feasible without a minimum number of customers. For example, without a minimum number of customers, installation of vending machines dispensing food and beverages is more practical than providing a food-and-beverage stand. In this case, space may be allocated for development of amenities that may be feasible as the customer base grows. In a shared terminal with potential users from the larger shared customer base, the provision of some amenities may be more feasible than in a dedicated terminal. An important consideration is the practicality of specific amenities for the customer base. For example, the passenger dwell time inside the offsite terminal will be less for a transportation link with 15-minute headways than it will be for a link with 1-hour headways. There are fewer amenities that make sense with shorter passenger wait times in the offsite terminal unless the amenities are accessible and useful for the general community in the vicinity of the offsite terminal.

The potential amenities for an offsite terminal are

- Areas for sales of food and beverage and other retail uses including newsstands, drugstores, gifts, flowers, dry cleaning, car wash, and automobile detailing (if consumption of food and beverage is prohibited on the transportation link, food and beverage sales may not be feasible);
- Rental car counters, which could potentially increase the attractiveness of the offsite terminal and transportation link for non-residents who need to rent an automobile for travel within the region, but which would require space on or near the premises for rental car pick-up and drop-off, storage and ready return;
- Flight Information Display System (FIDS) to inform customers and meeters/greeters about departing and arriving flights;
- Airline ticketing kiosks for flight check-in;
- Airline ticket counters (because of the current financial state of the U.S.–based airlines, airline staffing in remote locations may be a phenomenon of the past);
- Wireless internet access;
- Electrical outlets for passengers to charge electronic equipment;
- Business center;
- Remote luggage check;
- On-site screening of passengers and luggage; and
- Other services found in an airport terminal.

Remote Luggage Check

For enplaning passengers, it is more efficient for luggage check-in to be operated by a third-party operator who can process luggage for a large number of airlines compared with multiple airlines providing luggage check at the offsite terminal. This is currently being offered at some offsite terminals, cruise ship terminals, convention centers, and hotels. The luggage is accepted at the off-airport location and screening is conducted at the airport. The logistics of transporting the luggage to the airport, security screening, and distributing to individual flights at the airport may require luggage check-in times of 2.5 to 3 hours before flight time, which may not be practical for some passengers. If the passenger is not required to be on the same bus as the luggage, the service may be appealing to passengers who drop off the luggage in advance of the flight and return for a later bus to the airport.

For deplaning passengers, the provision of luggage checked through to the offsite terminal would require a system for airlines to tag luggage throughout the flight network and efficient retrieval at the airport to prevent long wait times at the offsite terminal.

On-site Security Screening of Passengers and Luggage

On-site security screening of both passengers and luggage could serve as an incentive for more customers to use the offsite terminal since it would save passengers time and avoid inconvenience at the airport. If a procedure was developed that enabled air passengers to be screened for security at the offsite terminal on terms that were acceptable to the airlines, the airport operator, and the Transportation Security Administration, passengers could be transported to the secure part of the airline terminal and avoid waiting in security lines at the airport.

Considerations for developing cutoff times for processing at the offsite terminal are: (1) the imposition of a long cutoff time for security processing at the terminal in relation to the flight departure time will diminish the appeal of using the amenity; and (2) cutoff times that lead to passenger arrival at the airport that are close to boarding times will reduce passenger exposure to on-airport concessions and lower the average passenger spend rate. Passengers are not likely to spend extra time at the concessions at the offsite terminal because they'll want to board the next transportation link to the airport to be near their departure gate.

Alternatives to passenger security screening at the offsite terminal are to provide a passenger screening area(s) on-airport for the processing of offsite terminal customers or to provide head-of-the-queue privileges at in-terminal passenger security screening for users of the offsite terminal, similar to when air passengers on next departing flights are permitted to go to the head of the queue.

Customer Access and Circulation

Space must be allocated on the offsite terminal property for ingress and egress of vehicles transporting customers to/from the offsite terminal. Thought should be given to whether the transportation link will share the same ingress and egress route with vehicles transporting customers to and from the site.

In addition to a short-term parking area for passengers being picked up and dropped off, curb space in front of the terminal should be made available for vehicles that are picking up and dropping off passengers and for taxi pick-up and drop-off. If there is a sufficient market for taxi service, space for a taxi stand should be allocated near the terminal. If other scheduled public transportation modes will serve the terminal, space near the terminal must be allocated for this function.

Bus Bays and Layover Area

If all of the customer pick-up and drop-off in low-occupancy modes will occur at the front of the terminal, the airport transportation link should be planned so that customers are served from

the side or from the back of the terminal to provide a dedicated area for the airport transportation link and to promote safety. For headways of a half-hour to an hour, there should be space adjacent to the terminal for at least two buses: one picking up and one dropping off. Since the buses are serving air passengers with luggage, it can be expected that it will take at least 5 minutes to unload baggage and for passengers to alight from an arriving bus. Departing buses should be at the boarding area at least 10 minutes prior to departure since it will take longer for passengers to board the bus and get settled, and it takes time to organize luggage that will be unloaded at the airport terminal (at airports having multiple terminals). Because of scheduling, it is possible for more than two buses to be at the offsite terminal at one time. There should be room in the boarding/alighting area for a third bus or space on the property for buses to layover when they are not in service. For headways of less than a half-hour, more space may be needed. When considering the layout for the terminal and bus zone, bus movements, including access and ingress routes and turning radii, must be taken into consideration.

Security

Airport customers must feel as safe using the offsite terminal and related parking as they feel using the airport terminal and parking. The location of the offsite terminal and related parking must be perceived as safe to potential customers. On-site staff provides a sense of security for customers and thought should be given to lighting as it relates to a secure environment. It may also be judicious for local police to patrol the offsite terminal from time to time, particularly in the late evening and early morning hours.

Hours of Operation

The offsite terminal should be open and staffed during all hours the airport transportation link is in operation.

CHAPTER 5

Costs and Benefits

There are costs and benefits associated with the financial performance of the offsite terminal and transportation link. Additionally, there are potential on-airport cost savings and revenue impacts and other important benefits due to vehicle trip reduction and emissions savings that may influence the project sponsor to go forward with an offsite terminal and transportation link even if it is projected to lose money. This chapter is organized into three sections:

- Financial performance of an offsite terminal and transportation link,
- Other benefits, and
- On-airport financial impacts.

Financial Performance of an Offsite Terminal and Transportation Link

The projected financial performance of the offsite terminal and transportation link may influence the project scope or the decision to go forward with the project. This section presents guidelines for developing the pro forma and information on the revenues and costs generated by an offsite terminal and transportation link.

Guidelines in Developing the Pro Forma

The pro forma is the vehicle for developing financial projections for the project and can be used as a tool to test scenarios during project planning such as different fare levels, parking rates, and costs and revenues associated with different amenities.

Depending on the goals and objectives of the project, it may be acceptable for the offsite terminal and transportation link to lose money, at least in the early years of the project, while the customer base is developing. One way to handle this in the pro forma is to treat the loss, or part of the loss, as a "contribution" or "investment" toward the primary project goals. For example, if the primary goal is traffic mitigation, the loss could be treated as a mitigation contribution. If the primary goal is customer service, the loss could be treated as a customer-service contribution.

Revenue Sources

Potential revenue sources include bus fare, parking fees, concession revenue and tenant rents, advertising, partnerships, and funding assistance such as grants.

Bus Fare

The project sponsor should introduce a fare on the airport transportation link that reflects local market conditions and is consistent with the project goals and objectives defined at the

beginning of the project. In theory, the market will support a price point that is considerably above any available combination of commuter-oriented public transportation services and below the price of on-airport parking, direct taxi/limousine service, and door-to-door shuttle services. The price-sensitive customer will compare the cost of using the airport transportation link and offsite terminal parking (if applicable) with the cost of more direct services, factoring in the size of the travel party (per-person fares) and the number of days away (daily rates). The time-sensitive customer will be less concerned about cost and more concerned about travel time, convenience, and reliability.

The following analysis can serve as a starting point for determining the fare on the airport transportation link:

1. **Calculate the fare required to achieve cost recovery (breakeven fare) on annual bus capital and operating costs for passengers using the service during the third or fourth year of service,** when ridership has reached maturity. During the first 2 to 3 years of service, the offsite terminal and bus link will be building its customer base as it becomes known and accepted by customers. Typically by the third or fourth year of service, the customer growth rate will be similar to the air passenger growth rate. Although it is instructional to determine the breakeven fare based on first and second year ridership projections, this calculation will most likely yield a fare so high that it discourages ridership. For a facility with constrained parking, full ridership potential for the bus may not be realized. This should be incorporated into the cost recovery analysis.

   If airport employees will be charged a lower fare than air passengers to use the service, calculate the breakeven passenger fare based on projected air passenger ridership and bus operating expenses less employee fare revenue. When establishing an amount for bus capital and operating costs, the project sponsor should make a decision about what percentage of the terminal capital and operating costs will be allocated to the bus operation and what percentage will be allocated to the parking operation.
2. **Compare the breakeven fare to the user cost of other modes in the market area,** particularly the low-occupancy-vehicle modes with which the airport transportation link is intended to compete. Travel party size and days away will influence this comparison. There are two ways to calculate the user costs of other modes in the market area, the difference being in how the cost of using an automobile is calculated:
   - The true cost of the trip to the passenger includes automobile operating costs and out-of-pocket costs (see Table 8).
   - Out-of-pocket costs include only the cost of using a service. For a pick-up or drop-off trip, the traveler may consider the cost to be nothing or the cost of the price of gas; for long-term parking, most travelers would consider the cost to be the parking fee and the price of gas.

Figure 4 presents an example of the difference between the true cost and out-of-pocket costs for an access trip to the airport.

The project sponsor may also consider introducing special fare categories for specific customer groups or categories such as children, senior citizens, or weekend travelers. Data on the breakeven fare for the transportation link compared with other modes in the market is one methodology that will allow the project sponsor to deliberate on the appropriate fare to charge in the context of its goals and objectives and to calibrate the fare to market conditions. Another approach would be for the project sponsor to offer a fare on the airport transportation link and a daily long-term parking rate at the offsite terminal that results in cost recovery or a profit for the project, with bus revenue subsidizing the parking operation or parking revenue subsidizing the bus operation. Alternative methodologies would incorporate revenue sources in addition to the transportation link and parking.

Table 8. True cost methodology for calculating one-way travel cost of airport ground transportation modes.

Mode/ Party Size	1	2	3	4
Offsite terminal bus dropped off at terminal	**Bus fare x party size**	**Bus fare x party size**		
Offsite terminal bus, long-term parking at offsite terminal	**((bus fare x party size) + (daily parking rate x days/2[a])) /party size**	**((bus fare x party size) + (daily parking rate x days)) /party size**		
Other Modes				
Taxi	(taxi fare + tip) / party size	(taxi fare + tip) / party size		
Door-to-door van	(door-to-door van fare + tip) x party size	(door-to-door van fare + tip) x party size		
Private automobile, drop-off [1]	(automobile operating cost [3] x 2) / party size	(automobile operating cost[3] x 2) /party size		
Private automobile, long-term park [2] Lowest on-airport daily parking rate	[(automobile operating cost [3] + parking cost [4]) / 2] / party size	[(automobile operating cost [3] + parking cost [4]) / 2] / party size		
Private automobile, long-term park [2] Lowest off-airport daily parking rate	[(automobile operating cost [3] + parking cost [4]) / 2] / party size	[(automobile operating cost [3] + parking cost [4]) / 2] / party size		
Private automobile, long-term park [2] Highest daily parking rate	[(automobile operating cost [3] + parking cost [4]) / 2] / party size	[(automobile operating cost [3] + parking cost [4]) / 2] / party size		
Additional modes	fare x party size	fare x party size		

Source: DMR Consulting

[1] A pick-up or drop-off trip by private automobile requires a two-way vehicle trip for a one-way air trip. For a drop-off trip, the driver travels to the airport and drops off the passenger and then departs the airport. For a trip by private automobile using long-term parking, the automobile remains at the airport until the air passenger returns; therefore, it is a one-way automobile trip for a one-way air trip. The American Automobile Association offers a per mile automobile operating cost that could be used for this calculation.

[2] The total cost of parking is divided in two to apportion the cost between two one-way trips.

[3] Automobile operating cost = per mile automobile operating cost x distance from offsite terminal to airport.

[4] Parking cost = daily parking rate x number of days.

Parking Fees

Air passengers who typically drive to the airport and use long-term parking will compare the price of long-term parking at the offsite terminal with the cost of parking they normally use at the airport as a factor in deciding whether to use the offsite terminal or drive directly to the airport. The project sponsor should be familiar with parking rates at on-airport and off-airport parking facilities (including discount rates) when developing parking rates for the offsite terminal. The parking rate at the offsite terminal should be priced lower than the parking facilities in the vicinity of the airport.

The project sponsor should compare the breakeven parking rate for the third or fourth year of the project with long-term parking rates on- and off-airport as a point of departure for ratemaking. During the third or fourth year of a successful offsite terminal, ridership on the airport

Assumptions:

- Distance = 21 miles
- Per mile automobile operating cost = $.52
- Airport daily parking rate = $12
- Party size = 1
- Length of stay = 3 days

User Cost, One-Way Automobile Trip

Mode	True Cost	Out-of-Pocket Cost
Drop-off	$21.84	$0.00
Long-term park	$28.92	$18.00

A pick-up or drop-off trip by private automobile requires a two-way vehicle trip for a one-way air trip. For a drop-off trip, the driver travels to the airport and drops off the passenger and then departs the airport. For a trip by private automobile using long-term parking, the automobile remains at the airport until the air passenger returns; therefore, it is a one-way automobile trip for a one-way air trip. The long-term parking cost for a one-way trip is the total parking cost

Figure 4. Comparison of user costs to access airport.

transportation link should be close to maturity. The breakeven parking rate is computed by dividing the annual capital and operating cost of the parking facility by the projected number of occupied parking spaces by day for the year. When establishing an amount for capital and operating costs of the parking operation, a determination must be made on what percentage of the capital and operating costs of the offsite terminal will be allocated to the bus operation and what percentage will be allocated to the parking operation.

If the offsite terminal is co-located in an intermodal center, it is possible that parking rates will be determined by the property owner. This may impact parking utilization and ridership if parking is priced too high.

Concession Revenue and Tenant Rents

This category includes revenue from vending machines and pay phones, concessionaires, and tenants such as food and beverage, retail, and rental car companies.

Advertising

Depending on project goals and objectives, revenue could be generated by selling advertising space on the property, in the terminal, and on the bus. The project sponsor should consider how particular advertising methods may impact the identity or image of the offsite terminal. Examples of advertising options include

- Billboards on the property;
- Advertising inside the terminal or the parking facility;
- Advertising placards inside the bus;
- Items to distribute to passengers on the bus such as luggage tags with a company logo or a complimentary copy of a newspaper or magazine;
- Advertising placed on the back of bus tickets or parking tickets;
- Naming rights to the terminal, the parking facility, or sections of either; and
- Advertising on the outside of the bus is not recommended unless it is subtle since the identity of the bus is important in attracting riders (this will be explained in Chapter 8: Branding, Advertising and Customer Service).

Partnerships

Partnerships may supplement revenue or lower costs. For example, the governing body in the jurisdiction in which the offsite terminal is located may provide a subsidy for the service or cover specific costs such as advertising to ensure the service is available for residents, businesses, or tourists, thereby increasing the appeal or visibility of a location. This might also be offered in the form of low rent or reduced rent by the property owner. If revenue sharing is a condition of the partnership and the project sponsor is the airport operator, this may be considered to be revenue diversion and should be explored with the FAA.

Funding Assistance

Funding assistance such as grants and funding vehicles may also supplement revenue or lower costs. Potential funding sources are explored in Chapter 7: Plan of Finance and Financial Feasibility.

Cost Categories

It is important for the project sponsor to estimate all the costs associated with planning, developing, and operating the offsite terminal and transportation link. Cost categories include capital and operating costs plus overhead.

Capital Costs

Included in capital costs are the following:

- Bus—any costs related to acquiring or equipping buses and capital costs of fare collection equipment.
- Parking—costs related to designing, constructing, and equipping the parking facility, including revenue control equipment and video monitoring equipment. Table 9 presents an estimate of construction costs for surface parking spaces as of January 2008. The cost of parking will vary by the type of facility and by labor and materials costs in the specific airport market area. Table 10 contains links to websites providing construction cost estimates for structured parking.

Table 9. Construction cost per surface parking space,[1] January 2008.

Range	High	Medium	Low
Cost	$4,000	$3,000	$1,600

[1]Does not include cost of land.

Source: Jacobs Consultancy

Table 10. Internet references for parking construction costs.

Structured Parking	Website
Parking Structure	www.rsmeans.com/calculator/index.asp
Surface Parking	www.city.newport-beach.ca.us/PlnAgendas/i03222007-05-02.htm tp.osu.edu/planning/southcampparkplan/AppendixD.htm www.vtpi.org/parking.xls www.vtpi.org/tca/tca0504.pdf

Source: Jacobs Consultancy

- Terminal—costs to design, construct, equip, furnish, and finish the terminal. Purchase price of property, if purchased, can be included here or apportioned between terminal and parking.
- Site preparation—costs to prepare the site including environmental impact studies, mitigation, and access from public streets to the facility.
- Project development—any other costs related to project development such as studies to project ridership and site selection analysis. If more than one property or geographic location is being considered, the project sponsor will determine how much of the cost should be allocated to the selected project.

Operating Costs

Included in the operating costs are the following:

- Bus—all costs related to the bus operation, which may include bus leasing costs; personnel; fuel; maintenance; fare collection (operating); or contract costs if operated and/or maintained by a third-party operator.
- Parking—costs to operate parking, which may include personnel, electricity, facility and equipment maintenance, cleaning, security, or contract costs if operated by a third party.
- Terminal—terminal operation costs, which may include personnel (e.g., terminal manager, bus ticket sales, and custodial staff); electricity and other utilities; maintenance; cleaning; security; or contract costs if operated by a third party. Leasing costs, if the property is leased, can be included here or apportioned between the terminal and parking.
- Advertising—costs to advertise the offsite terminal and transportation link.
- Administrative overhead—staff of the project sponsor who are not directly involved in the operation and upkeep of the offsite terminal and transportation link may charge time spent on the project to a cost center, or a percentage of operating costs may be applied as an estimate of staff time spent working on the project to account for time spent on duties such as performance measurement, reporting, accounting, surveying, and studies. The project sponsor may decide to exclude administrative costs from the pro forma.

Other Benefits

Other benefits of the offsite terminal and airport transportation link include reduced vehicle trips, savings in vehicle-miles traveled, and emissions savings.

Trip Reduction and Savings in Vehicle-Miles Traveled

Trip Reduction

Every customer of the offsite terminal and transportation link who would have used a lower-occupancy vehicle to travel to and from the airport represents a reduction in vehicle trips traveled on the regional roadways between the offsite terminal and the airport, local roadways used in the vicinity of the airport, on-airport roadways, and potentially on the terminal curbs. The number of vehicle trips generated by an air passenger is related to the travel party size and the mode used. Table 11 shows vehicle trips generated per enplaning passenger (VTPP) for sample passenger trips to an airport.

The best source of information for estimating vehicle trip savings for all passengers using the offsite terminal is an O/D air passenger survey, if available, that collects information on mode choice to the airport, travel party size, and resident status for a typical travel period. A typical travel period is a period that represents a typical passenger mix and volume of business and pleasure travel for the individual airport. The data can be used to develop a spreadsheet that calculates an average VTPP factor. This factor is then multiplied by the number of air passengers using

Table 11. VTPP by mode.

Mode (Examples of Single-Party Vehicles)	A: Number of Vehicle Trips to Airport	B: Number of Empty Vehicle Trips Departing Airport[a]	C: Party Size	Vehicle Trips per Passenger = (A + B)/C
Private automobile: long-term parking	1	0	2	.5
Private automobile: long-term parking	1	0	1	1
Private automobile: drop-off	1	1	2	1
Private automobile: drop-off	1	1	1	2
Taxi	1	.4[b]	2	.7

[a]Vehicles that are not parked at the airport for the duration of the air traveler's trip depart the airport. All drop-off trips by private automobile will depart the airport without air passengers. A percentage of taxi trips and private limousine trips will leave the airport empty.

[b] In this case, 40% of taxi trips depart the airport without a passenger.

Source: DMR Consulting

the airport transportation link to estimate vehicle trips saved to the airport. Table 12 provides a template to arrive at the VTPP factor. The VTPP factor is as follows:

Air passenger vehicle trips saved = average VTPP × projected (or actual) air passengers using transportation link

Typically this calculation will be used to estimate annual trips saved or average daily vehicle trips saved.

If the customer base for the offsite terminal and transportation link is projected to be predominantly residents, then the above template should be developed based on mode share and travel party size of resident air travelers. For HOV trips to the airport, including shared-ride vans and buses, a vehicle trip per passenger number can be calculated, but its use in a vehicle trip savings calculation would be suspect since scheduled HOV trips will still occur and many shared-ride vehicle trips will still occur with the other passengers that would have been in the vehicle.

A similar factor can be developed for airport employees and applied to the number of employees projected to use the transportation link. However, unless the airport has an active employee transportation program encouraging the use of ridesharing and alternative modes to get to work, most employees will drive alone. Therefore, it's reasonable to assume that one vehicle trip is saved for every employee using the offsite terminal and transportation link.

Net vehicle trips saved includes vehicle trips saved by airport employees and air passengers and adjusts the savings by the number of trips made by the airport transportation link, if the vehicle is a bus or a van. If the transportation link is a rail link, the number of trips equals zero:

Net vehicle trips saved = air passenger vehicle trips saved + employee vehicle trips saved − trips made by airport transportation link

The estimated number of net vehicle trips saved can be used as part of project evaluation during project planning, and actual vehicle trips saved can be used to measure progress once a service is operational. Metrics can also be developed for financial performance such as cost (or deficit) per vehicle trip saved.

Table 12. Template to develop average VTPP factor.

Mode	A: Share of O/D Passengers	B: Number of O/D Passengers[1] = A x (average daily O/D passengers)	C: One-way vehicle trip	D: Empty Trip[2]	E: Average Party Size	F: Total Vehicle Trips = B/E x (C+D)	VTPP
Private automobile: pick-up/drop-off			1	1			=F/B
Private automobile: long-term park			1	0			=F/B
Rental car			1	0			=F/B
Taxi			1	0<=taxi<=1			=F/B
Single-party limousines				0<=limo<=1			=F/B
Other single-party modes				0<=other modes<=1			=F/B
Total	Will be less than 100% unless there are no HOV modes to the airport	Sum column	N/A	N/A	N/A	Sum column	Average VTPP = Total F/ Total B

[1]Typically applied to average daily air passengers.

[2]Empty trips for commercial vehicles can be calculated if data is available or estimated based on knowledge of the service. Taxi regulations at the airport will influence the number of empty vehicle trips.

Source: DMR Consulting

Vehicle-Miles Traveled

Savings in vehicle-miles traveled (VMT) is also a measure of performance and is a benefit derived from offering the offsite terminal and transportation link. An offsite terminal located 15 miles from the airport that attracts as many customers as does an offsite terminal located 10 miles away offers 50% more savings in regional VMT, even though the number of vehicle trips saved from each offsite terminal is equal.

For an offsite terminal and transportation link located at a site with little or no public transportation access, it is reasonable to assume customers will use low-occupancy modes to access the offsite terminal. Thus, there will be no savings in VMT between the trip origin or destination and the offsite terminal. The savings in VMT will occur between the offsite terminal and the airport:

Net savings in VMT = net vehicle trips saved × distance between offsite terminal and airport

For an offsite terminal and airport transportation link located at an intermodal facility, some customers may take advantage of high-occupancy modes to the offsite terminal to use the airport transportation link. Prior to the introduction of the airport transportation link, these customers may have taken low-occupancy modes to the airport.

The savings in VMT for this type of trip would be greater than the distance between the offsite terminal and the airport. If a significant number of the offsite terminal customers use HOV modes to transfer to the airport transportation link, data for estimating the savings in VMT between the origin or destination point and the offsite terminal can be gathered as part of a user

survey. This data should be gathered and analyzed once ridership has reached maturity, typically in the third or fourth year of service. Necessary data would be obtained by asking the following questions:

- Where do you live?
- Where did you begin your trip to the offsite terminal?
- How did you get to the offsite terminal? and
- If the offsite terminal and airport transportation link were not available, how would you travel to the airport?

The estimated savings in VMT can be used as a performance measure during project planning, and actual VMT savings can be used to measure progress once a service is operational. Metrics can also be developed in relation to financial performance such as cost (or deficit) per VMT saved.

Emissions Savings

An offsite terminal and transportation link can potentially reduce air emissions. However, there is not a direct relationship between VMT and air pollution impacts. Buses and cars emit pollutants at different rates, depending on the particular pollutant. In addition, each pollutant has a different impact on health and greenhouse warming. A transit air benefits calculator was developed for this project. The purpose of the calculator is to help the sponsor of the offsite terminal and transportation link determine the net environmental benefits resulting from the reduction in low-occupancy vehicle trips by offsite terminal customers. The appendix begins with a primer identifying and describing the impacts of various pollutants, which is followed by a user guide for the transit air benefits calculator.

On-Airport Financial Impacts

A successful offsite terminal and transportation link may offer savings in on-airport costs. It may also be responsible for lost on-airport parking revenue from customers who would have otherwise parked.

On-Airport Cost Savings

To the extent that airport expansion, reallocation of space, or additional operational costs can be reduced or avoided due to the offsite terminal and transportation link, the cost savings should be considered in the context of the projected or actual financial performance of the offsite terminal and transportation link. Example situations include, but are not limited to the following:

- Airport roadway and terminal curb space is at capacity and introducing one or more offsite terminals may
  - Mitigate the need for expansion and/or
  - Reduce the level of traffic management and enforcement resources.
- Airport passenger parking is reaching capacity and introducing one or more offsite terminals may
  - Reduce on-airport public parking demand, eliminating, reducing, or delaying capital costs associated with expansion and/or
  - Eliminate the need for additional on-airport employee parking or enable some on-airport employee spaces to be converted to other uses if the offsite terminal is utilized by airport employees.

In all likelihood, introduction of one offsite terminal will not eliminate the need for an existing terminal, a terminal expansion, or a new on-airport terminal because provision of

Table 13. Market share of express bus ridership, BOS and LAX, 2006.

Airport/Route	O/D Enplanements	Enplaning Air Passenger Ridership[a]	Share of O/D Enplanements
LAX: VNY FlyAway	19,520,000	342,005	1.8%
LAX: Union Station FlyAway	19,520,000	110,535[b]	0.6%
FlyAway System	19,520,000	452,540	2.3%
BOS: Braintree Logan Express	12,465,000	169,360	1.4%
BOS: Framingham Logan Express	12,465,000	174,835	1.4%
BOS: Woburn Logan Express	12,465,000	83,220	0.7%
Logan Express System	12,465,000	427,415	3.4%

[a]Air passenger ridership only. Employee ridership is significant on each service.

[b]Represents air passenger ridership during the 1st year of service. Air passenger ridership on the Union Station FlyAway increased by approximately 25% during the second year of service.

Source: DMR Consulting based on data from LAWA and Massport.

all of the services offered in an airport terminal in the offsite terminal is likely to be more expensive per passenger, even if real estate is less expensive at the offsite terminal. The offsite terminal will not capture as many passengers as the on-airport terminal because the market area for one offsite terminal is a fraction of the market area for the entire airport. Chapter 3: Market Determination provides an explanation of how to estimate the market area for an offsite terminal.

Table 13 shows annual O/D air passenger enplanements at BOS and LAX and the number of enplaning air passengers using their offsite terminals. Although each route carried a healthy ridership, the individual routes served less than 2% of enplaning air passengers.

Unless regulations are changed, passengers must still clear security at the airport. The typical air passenger will feel more comfortable if the majority of his or her waiting time prior to the flight is in proximity to the flight boarding area. For that reason, passengers will prefer to linger at the airport and not at the offsite terminal.

On-Airport Revenue Reduction

Offsite terminals will reduce future on-airport revenue from air passengers who would have accessed the airport by private automobile and used on-airport long-term or short-term parking. Revenue from on-airport taxi and limousine usage trip fees will also be lower, to the extent that passengers who would have traveled to the airport by these modes choose to use the offsite terminal. Assuming that the airport access mode distribution of air passengers using the offsite terminal would have been approximately the same as the access mode share distribution of the overall air passenger population if the offsite terminal did not exist, one methodology for estimating revenue loss is the following:

1. Apply mode shares from the air passenger survey as in Table 12 to projected or actual passengers using the airport transportation link. Eliminate the proportion of passengers who would use privately operated off-airport parking from this calculation.
2. Divide by average travel party size as in Table 12 to calculate the number of vehicles by mode that would be traveling to the airport.
3. Multiply the estimated average length of stay for vehicles parking at the offsite terminal by the on-airport parking rate. If there is more than one on-airport long-term parking rate, apply the proportion of on-airport vehicles by parking facility to the number of long-term vehicles

parked at the offsite terminal and multiply the resulting vehicles by length of stay, by the commensurate rate.

4. Multiply the average on-airport ticket price for short-term parking by the number of vehicles that would have used short-term parking on-airport. Apply the split between pick-up/drop-off using short-term parking and curb pick-up/drop-off to the number of pick-up/drop-off vehicles to get the number of vehicles that would have used short-term parking.
5. Multiply the taxi access fee by the number of taxis that would have traveled to the airport. This can be obtained from calculations in Table 12.
6. Multiply the limousine access fee by the number of limousines that would have traveled to the airport. This can be obtained from calculations in Table 12.
7. For any other low-occupancy-vehicle modes, multiply the fee by the number of vehicles that would have traveled to the airport. This can be obtained from calculations in Table 12.
8. The total on-airport revenue lost is the sum of the revenue lost from each mode.

If the majority of air passengers using the terminal are projected to be residents, use the mode share and average vehicle occupancies for residents to estimate revenue loss. If the split of residents and non-residents is projected to be closer to the split for the overall airport O/D population, use the mode share for the overall airport population. Passengers that would have used privately operated off-airport parking that use the offsite terminal represent a gain in overall revenue to the airport operator.

If the offsite terminal offers amenities that cause passengers to spend significantly less time at the airport, there may be an impact to on-airport revenues. The net impact would be determined by comparing changes in on-airport revenue streams with similar revenue streams generated by the offsite terminal.

CHAPTER 6

Plan of Finance and Financial Feasibility

The typical steps required to obtain funding and any necessary financing for projects are

1. Plan the project in coordination with other government agencies, considering how the offsite terminal and transportation link may fit with local and regional transportation goals in addition to the airport-related goals of the project sponsor;
2. Determine whether any capital grants or operating assistance is available for the service;
3. Calculate the revenues generated from any offsite terminal and the connecting transportation service (as described in Chapter 5); and
4. Assemble the final financial plan.

State and Local Coordination/Funds

The offsite terminal planning process should start with airport sponsors working with other state and local officials, as well as local offices of federal agencies through the Metropolitan Planning Organization (MPO). It is a current policy of the U.S. DOT "to encourage the development of intermodal connections on airport property between aeronautical and other transportation modes and systems to serve air transportation passengers and cargo efficiently and effectively and promote economic development."(*1*) See Case Study 1 for an example of an intermodal terminal.

Airports may be eligible for intermodal planning assistance through monies made available to MPOs through the FHWA and FTA planning programs. These funds require that the access project be part of the local Transportation Improvement Program; with its inclusion, the project approval process, including required environmental reviews, is streamlined considerably.

These goals will be best achieved if airport officials and the local MPO or state DOT coordinate their planning, including demand forecasts, environmental impacts, land use, and airport access connections.(*2*) Through this coordination, airports are also more likely to be made aware of the full range of federal capital, operating, and credit assistance available through FHWA and FTA. Decisions regarding the use of FHWA and FTA funds are most often made at the MPO and state level; FHWA and FTA provide final approval for the projects selected at the local level. States can also provide access to financing such as the Florida State Infrastructure Bank (SIB) loan being used for a segment of the funding for the Miami Intermodal Center.

CASE STUDY 1
Bus Service to Intermodal Terminal

- Boston, Massachusetts: Silver Line bus rapid transit service between South Station in downtown Boston and Logan International Airport
- Capital Funding: Massachusetts Bay Transportation Authority (MBTA)(local transit); FTA (buses); and Massport (buses)
- Operating Costs: Fare box and Massport (Airport Revenue)

In June 2005, bus rapid transit service was introduced between Boston Logan International Airport and South Station. South Station is located 4 miles from Logan Airport. It was built in 1899 as a rail station and has transformed over the years into an intermodal center serving Amtrak, Massachusetts Bay Commuter Rail, intra-city bus, and inter-city bus (Greyhound and Peter Pan) operations. As a mixed-use development, it features dining and retail in addition to the multi-modal transportation services. In an effort to meet a stated agency goal of achieving 35.2% HOV ground access to the airport, Massport partnered with the MBTA to develop the Silver Line Route 1 (SL1). Most of the infrastructure and development costs were paid for with MBTA and FTA (Section 5307 and Section 5309) funds. Massport contributed $13.3 million in capital funds to purchase eight low-emissions buses. The 60-ft articulated dual-mode buses run on low-sulfur diesel when on roads and on electricity while in the tunnel and are able to use the 600-volt overhead system.

The Silver Line buses serving the airport are identified by the Massport logo on their exterior. MBTA staff at South Station direct airport passengers to the appropriate SL1 route. Internally the buses are uniquely configured with luggage racks. Massport contributes approximately $2 million annually towards operating expenses and receives the fare revenues for all passengers who originate at Logan Airport.

Massport has been pleased with the publics' use of SL1. As of September 2007, ridership averages 3,500 daily boardings, which includes air passengers and airport employees.

Federal Funding Sources

Because offsite terminals take many forms and connect to airports in various ways, the plans for financing the capital and operating costs of a terminal and its airport transportation link will vary considerably. Among the most important variables are the location of a terminal, the types of transportation connections to the airport, and the passenger processing functions performed.(*3*)

Given the importance of funding to the project's feasibility, all possible sources of federal and local funds should be identified early on in the project development process. Federal grant funds are available for transportation projects, but, because these sources are modally based, there are strict rules about the ways in which these monies can support multimodal projects such as access from an offsite terminal to an airport.

Additional rules govern eligibility for federal capital grants, the use of passenger facility charge (PFC) revenue, as well as revenue generated on the airport. All are governed by federal laws, regulations, and existing contracts that require careful consideration and consultation with appropriate agencies when planning an offsite terminal and transportation service. Together with any

operating revenue generated by services offered at the offsite terminal or through the transportation link, these sources of revenue provide the resources to back the capital and operating costs of the operation.

Federal Planning Grants

To the extent individual offsite terminal projects can be made part of overall airport and regional planning, it is likely to increase the potential for planning support and capital funding assistance. At the FAA, the Airport Planning and Programming Office (APP) administers the airport planning process and provides financial assistance to airport sponsors to complete individual airport master plans and area-wide system plans. These funds amount to approximately $70 million annually, which is about 2% of overall FAA capital grants made available to airports for all planning. Among the items eligible, as part of these comprehensive efforts, are "airport coordination and the analysis of procedures for transfer of passengers or baggage to bus, van, taxicab, rental car, automobile parking as well as innovative access facilities."(*4*) Questions about the planning process and funding should be directed to the appropriate FAA Airport District Office.

Federal Grants: FAA's Airport Improvement Program

The FAA provides approximately $3.5 billion in federal capital grants to airports under the Airport Improvement Program (AIP), approves airport sponsor PFC applications, and oversees the use of aeronautical and non-aeronautical revenue collected and spent by airports. The AIP program is funded by aviation-user taxes. AIP grants are made available to airports through two methods: (1) entitlement funds, which are apportioned to airports based on levels of passenger traffic and landed weight (for the cargo entitlement funds); and (2) discretionary funds, which are distributed based on a proposed project's ranking in relation to other projects deemed most important for improving the national air transportation system.

When an airport accepts AIP grant funds, it agrees to abide by a number of sponsor assurances and grant certifications that specifically guide how the airport manages not only the grant funds, but also the airport's other sources of aeronautical and non-aeronautical revenue. At the heart of the grant assurances is a requirement that airports use revenue on "the capital or operating costs of the airport; the local airport system; or other local facilities which are owned and operated by the owner or operator of the airport." This requirement—to not illegally divert revenue from the airport for a non-aviation and/or non-airport purpose—limits the use of airport revenue for offsite terminal projects that cross the airport's boundary. For a full list of grant assurances and other requirements, see www.faa.gov/airports_airtraffic/airports/aip/grant_assurances/.

The federal share of projects depends on the hub classification of the airport sponsor. Large- and medium-hub projects are generally funded at a 75% federal share, while small hubs and smaller airports are generally funded at a 90% or 95% federal share.

The FAA places a priority on airside and terminal needs projects. An offsite terminal would be AIP eligible if it meets the following criteria:

- **Is On-Airport:** AIP projects normally must be located entirely within the airport boundary or within a right-of-way acquired by the airport (the airport sponsor must retain and control ownership of any right-of-way for the life of the project). Within this criterion, however, there may be flexibility for an offsite and off-airport property terminal if it is owned (or leased long-term) by the airport and exclusively provides passenger processing functions. Especially for projects in this area, interested sponsors should work with the FAA regarding any questions about eligibility.

- **Serves Airport Traffic:** AIP eligible projects must exclusively serve airport traffic. The FAA has interpreted this to mean that only "incidental use" by non-airport users is permitted. This typically requires that for any projects within a multi-modal or multi-use building, airports must build into the project's design the ability to separate airport traffic from non-airport traffic.
- **Retains Ownership:** The airport must retain ownership of the completed project, although it may lease the responsibility for operating a ground transportation service to a local or regional agency.

Terminal development projects are eligible for AIP funds only for public, non-revenue-producing areas that are directly related to the movement of passengers and baggage. Large-, medium-, and small-hub airports are also restricted to the use of entitlement funds, not discretionary, for terminal development. Eligible items include baggage-claim delivery areas, automated baggage-handling equipment, public-use corridors to boarding areas, central waiting rooms, restrooms, holding areas, and foyers and entryways.(5) The FAA recommends that its Airport Financial Assistance office be consulted prior to any programming work on a multimodal terminal building. In the case of any offsite terminal building, this is especially advisable given the complexities of issues involved in seeking eligibility.

On-airport transit systems (e.g., automated people movers, buses, and rail systems) are also eligible for AIP funding. These include both the system itself (e.g., the vehicles, track, and operational controls for the system) and the stations. Eligibility is limited to the portions of a system designed for passenger access; all other uses, such as use by employees, would require a proration of eligible costs.

If an on-airport station is part of a larger transit system and is not at the "end of the line"—meaning non-airport passengers pass through the airport—the "through portions" of the station would be ineligible for AIP. Those portions of the station that are connected exclusively to the airport (e.g., by a walkway) would be eligible. Case Study 2 provides an example of the airport, the MPO, and other local agencies working together to fund an integrated transit link to the airport.

Federal Grants: TSA Programs

Beginning in Fiscal Year 2009 (October 1, 2008), the Department of Homeland Security's TSA has grant monies available to help airport sponsors with the costs of screening checked baggage. Legislation was passed as part of P.L. 110-53, "Implementing Recommendations of the 9/11 Commission Act of 2007." Specifically, Congress has provided $250 million annually through 2028 ($5 billion) to help defray costs related to the installation of "in-line" baggage systems at airports. While the vast majority of this funding will likely be dedicated to security costs at on-airport passenger terminals, off-site terminals that envision a full array of passenger processing functions, including ticketing and checked baggage, could be eligible. Interested airports are advised to discuss the matter with their local TSA Federal Security Director, the coordinator of federal security at the nation's airports.

Federal Grants: FTA Programs

The federal surface transportation programs from 2005 through 2009 are authorized under SAFETEA-LU. FTA's approximate $9.3 billion of funded programs range from those that provide substantial capital support for "transit systems," including bus and fixed-guideway projects (i.e., commuter and light rail), as well as support for clean fuel buses, the transportation needs of the disabled and elderly, and operational support for smaller transit systems. In all cases, coordinating the planning of a project with FTA Regional Offices, MPOs, and/or state DOTs is necessary to qualify for funding. Specific funding sources include Section 5307, "Urbanized Area Formula Program"; Section 5308, "Clean Fuel Grants Program"; Section 5309, "Capital Program"; and several other smaller programs. Section 5307 provides formula grants made available to urbanized areas. An

CASE STUDY 2
Integrated Transit System Link to Airport

- Portland, Oregon: Light-rail transportation service from downtown Portland to Portland International Airport (Airport Max)
- Capital Funding: TriMet ($46 million); City of Portland ($23 million); Cascades Council of Governments ($28 million); and Port of Portland ($28 million)
- Operating Costs: Fare box and TriMet

On September 10, 2001, light-rail service along a 5.5-mile extension of Portland's existing 33-mile light-rail system began between downtown Portland and Portland International Airport. The $125 million project was a collaborative effort among local governments including TriMet (the local public transit operator); the City of Portland; the Cascades Council of Governments; and the Port of Portland (the airport operator). In addition, the airport engaged a developer, Bechtel, in a public-private partnership where the airport acquired 120 acres of land and leased it back to Bechtel exclusively for 85 years. This acquisition provided additional airport land for the light-rail operation and allowed the airport operator to fund its $28 million share of the project with PFCs and airport revenue for the on-airport portion of the light-rail line. The project also received $46 million from TriMet, $23 million from the City of Portland, and $28 million from the Cascades.

Critical to the Airport Max project was the local committee set up to coordinate action among the various local and state agencies. Included on the committee was Portland's Mayor; the City Transportation Commissioner; TriMet; the Port Director (airport); the Director of the Oregon DOT; and MetroExecutive, the regional MPO.

The project has provided a successful alternative to congested roadways, enabling passengers to use transit between the airport and downtown Portland. Because the airport link is part of a larger transit operation, traffic is aggregated from several regions throughout the Portland area. On average, approximately 5% of O/D passengers are using the service, slightly above initial estimates.

urbanized area is an incorporated community with a population of 50,000 or more. For urbanized areas of more than 200,000, grants are distributed directly to the recipient. For those of fewer than 200,000, funds are distributed to governors to allocate according to the individual state's process.

Capital programs are generally funded with an 80% federal share, but FTA policy favors those projects that are more highly leveraged (i.e., requiring a lower federal commitment). Limited operating assistance is available for urbanized areas under 200,000. Generally, however, the focus of FTA funding is on capital projects.

Advocates of airport access projects, either standalone systems or those that are part of larger transit systems, would work through their local MPO and state DOT to apply for funding. Projects that are part of the transportation link for an offsite terminal would generally fall under Section 5307 (a formula-based program) or 5309 (a discretionary program). In addition to the projects listed above, intermodal stations and park-and-ride stations are eligible for funding. In recent years, Congress has earmarked all available funding for the program, meaning that project proponents should contact their local member of Congress in addition to their MPOs and local FTA office.

Federal Grants: Congestion Mitigation and Air Quality Improvement Program

The Congestion Mitigation and Air Quality Improvement Program (CMAQ) is a program within SAFETEA-LU that focuses on reducing tailpipe emissions of ozone and carbon monoxide. Jointly administered by FHWA and FTA, funding is available to metropolitan areas that do not comply with federal air quality standards (non-attainment areas) or previously did not comply but do so today (maintenance areas). Priority for CMAQ funds are given to diesel engine retrofits and other effective emission-reduction and congestion-management activities. CMAQ opportunities should be considered for possible funding of the transportation link between an off-site terminal and the airport. Information on nonattainment and maintenance areas can be found at www.epa.gov/oar/oaqps/greenbk/ancl.html.

The inter-agency coordination recommended previously is especially important if CMAQ funds are to be obtained. While CMAQ funds are administered by FHWA and FTA and these agencies make the final determination of eligibility, the actual project selection is made by either the state or local MPO, according to the state and/or local planning process.

CMAQ funds may be used for capital needs such as to establish new or expand existing transportation projects. CMAQ also makes limited and temporary operating assistance available to new transit services and intermodal facilities. Transit facilities must be associated with new or enhanced mass transit services to be eligible. Activities such as fringe parking are eligible if they are explicitly aimed at reducing single-occupancy-vehicle travel and the associated emissions. Fringe parking is used by cities to reduce downtown congestion by building spaces on the "fringe" or edge of downtown and then using mass transit to move travelers within the downtown area. As such, a multimodal transportation center that provided airport access would be a candidate for CMAQ funding.

Local Funding Sources

Passenger Facility Charges

In 1990, Congress enacted legislation to provide airports with an additional source of local funding for capital projects, subject to FAA approval, in the form of PFCs. The Aviation Safety and Capacity Expansion Act of 1990 required the U.S. DOT to issue regulations under which a public agency may be authorized to impose a PFC of $1.00, $2.00, or $3.00 per enplaned passenger at commercial airports it controls. Under this act, eligible airport-related projects are those that preserve or enhance safety, capacity, or security of the national air transportation system; reduce noise from an airport that is part of the system; or furnish opportunities for enhanced competition between or among air carriers.

The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21) included authorization for a public agency to charge a PFC at the $4.00 and $4.50 levels if the projects meet specific eligibility requirements. One such requirement, which applies only to large- and medium-hub airports, is that a project must make a "significant contribution" to improving air safety and security, increasing competition, reducing congestion, or reducing noise (in comparison to the "adequate justification" requirement for projects at a lower level). For operators of large- and medium-hub airports that are approved to collect a $4.00 or $4.50 PFC, passenger entitlement grants are reduced by 75% (rather than the 50% associated with lower PFC levels).

Currently, more than $2.2 billion in PFC revenues are collected by airport operators. PFC revenues are (1) used on a "pay-as-you-go" basis, where PFC collections and interest earnings are

spent directly on capital projects and/or (2) leveraged, that is, used to pay debt service on bonds or to repay other forms of debt.

Sponsors must follow FAA regulations when allocating PFC revenue to project costs. All PFC projects must meet the AIP criteria presented above. Additionally, there are separate PFC eligibility requirements that must be met. A project like an offsite terminal is something that the FAA encourages PFC applicants to develop in coordination with appropriate local and regional transportation agencies in order to ensure that all possible sources of funding are explored prior to assessing air travelers a fee for ground transportation projects. The specific eligibility requirements for an airport to use PFCs for an offsite terminal project include

- **Project lead:** The airport sponsor must be the final authority on a project that may involve other local agencies. This requirement ensures that the imposition of a PFC is not regulated by an agency other than the airport.
- **PFC eligibility:** The project must meet one of the PFC program objectives. The objectives are
  - Preserving or enhancing the safety, capacity, or security of the national air transportation system;
  - Reducing noise or mitigating noise impacts resulting from an airport that is part of such system; or
  - Furnishing opportunities for enhanced competition between or among air carriers.

  The eligibility of an offsite terminal could possibly be established by citing projected improvements in the capacity of the national air transportation system. An offsite terminal might also be justified through the capacity enhancements it provides for the airport. For example, a space-constrained airport may realize gains in capacity and efficiency if a certain amount of baggage screening and sorting is moved to the offsite terminal. In addition, the reduction in low-occupancy vehicles on-airport due to use of the offsite terminal will improve traffic flows on terminal roadways and curb areas, potentially alleviating the need for roadway and curb expansion.
- **Significant contribution for $4.50 PFC at large or medium hubs:** The project must demonstrate that it makes a significant contribution to
  - Improving air safety and security;
  - Increasing competition among carriers;
  - Reducing current or anticipated congestion; or
  - Reducing the impact of aviation noise on people living near the airport. Terminal space constraints are also likely to be contributing factors to this justification—for example, moving functions to an offsite terminal may provide the space necessary to build extra gates that could be used by an airline new to the airport. While this test looks similar to that listed above, it is more stringent and there can be greater variations in how FAA offices apply the criteria.

  Reducing congestion is the usual route that airports attempt in order to meet the significant contribution test. In determining whether an airport would meet the test, FAA considers the following questions:
  - Does the project support or is it a part of a capacity project to which the FAA has allocated federal resources or that would qualify for such resources?
  - Is the project included in an AIP Letter of Intent or does it satisfy the FAA's benefit-cost criteria for large AIP discretionary investments?
  - Has the project been identified as an important item in an FAA Airport Capacity Enhancement Plan? or
  - Does the project alleviate an important constraint on airport growth or service?
- **Adequate justification:** The program must be adequately justified. Showing reduced travel times directly for potential passengers and showing the reduced travel times for those using congested roadways relative to the cost of the project are two strategies for justifying a project.

- **Airside needs test (for $4.50 PFC):** The airport must show that it has made adequate provisions for financing the airside needs of the airport (including runways, taxiways, aprons, and gates). The FAA typically reviews planning and inspection documents to determine the airside needs, comparing them with the airport's capital plan.
- **AIP funding test (for $4.50 PFC):** The test requires that the FAA make a finding that the project cannot be paid for from AIP funds reasonably expected to be made available for the airport.

The House version (HR 2881) of the FAA reauthorization bill pending before Congress (as of December 2007) has a provision, Section 114, "Intermodal Ground Access Project Pilot Program," that would provide additional eligibility for ground access projects at up to five airports. Unlike current law that restricts the use of PFC revenues to projects that serve airport traffic exclusively, airports would be able to use a pro-rated share of PFC revenues based on the overall share of airport traffic served by the access project. For example, if an airport station was part of a larger transit system with 70% of riders being through-passengers and 30% airport traffic, 30% of the facility or infrastructure's capital costs that are on-airport would be PFC eligible.

Airport Bonds and Airport Revenue

Airport operators are major and regular participants in the municipal bond markets. At medium- and large-hub airports, airport revenue bond proceeds constitute the most significant source of funding, accounting for 58% of total funding for airport capital projects. (*6*) Major investor services use rating systems to grade bonds according to investment quality to inform potential investors about the creditworthiness of specific types of bonds at specific airports. The three major credit rating agencies—Moody's Investors Service, Fitch Ratings, and Standard & Poor's—have concluded that, on the whole, the airport system has performed well. It would be likely that the financing plan for an offsite terminal would involve some form of bonds issuance.

Airport Bonds

Airport revenue and PFC revenues are the most common sources used to back airport bonds. Five basic types of bonds are issued to fund airport capital improvements, including

- General obligation bonds supported by the overall tax base of the issuing entity (the airport sponsor);
- General airport revenue bonds (GARBs) secured by the revenues of the airport and other revenues as may be defined in the bond indenture;
- Bonds backed either solely by PFC revenues or by PFC revenues and airport revenues generated by rentals, fees, and charges;
- Special facility bonds backed solely by revenues from a facility constructed with proceeds of those bonds; and
- Other debt instruments.

Airport Revenue

Especially at larger airports, the majority of capital projects use airport revenue as their source of funding. This revenue is generated by the use of airport facilities (e.g., runways, terminals, parking lots, concessions) and by airlines, passengers, and others using the airport. The use of all airport revenue is governed by sponsor assurances that accompany the receipt of federal grant money (AIP) by the airport.(*7*) The set of rules for the use of revenue is quite similar to those enumerated above for AIP grants and PFC revenues. The FAA has approved the use of airport revenue for airport stations and the connections between the airport and the nearest mass transit line provided that they are located entirely on airport property and are designed for the exclusive use of airport passengers.

These rules do not restrict the use of bus connections to airports such as the LAX Flyaway non-stop bus routes operated by LAWA and the Logan Express non-stop bus routes operated by Massport. Manchester Boston Regional Airport runs a complimentary shuttle with stops in Woburn and Boston. The shuttle services the airport and is subsidized through the use of revenue generated by the airport. To protect against non-airport passengers utilizing the service, airport passengers must show a boarding pass or a printed travel itinerary as they board the shuttle. As long as the buses are used exclusively for airport service, capital and operating costs are eligible uses of airport revenue.

Customer Facility Charge Bonds

Customer facility charges (CFCs) are collected through rental car concessionaires and may be assessed on a per transaction basis or per transaction-day basis. CFCs are usually established pursuant to an ordinance that establishes the CFC amount, and the CFC may thereafter be part of the airport's annual setting of rates and charges. Airport operators have a good deal of discretion in setting and charging CFC fees since there is no requirement for federal oversight or approval of the CFC or transportation fee. Traditionally CFCs have been levied to pay all or a portion of the operating and capital costs of a consolidated rental car area or structured facility. CFCs may also include the costs of transportation to the terminals. If a rental car facility were to be part of the offsite terminal, CFC bonds, backed by future CFC revenues, are the types of bonds most likely to be used to finance that portion of an offsite terminal project. CFC revenues may be used on a standalone basis to leverage bonds or may be used together with other airport revenues to support bonds (known as a "double-barreled bond").

Federal and State Credit Assistance

An offsite terminal may have access to other credit assistance beyond that which is normally available for airport projects. The roadway congestion relief that would potentially be realized due to the offsite terminal may make the project eligible for programs meant to facilitate development of surface transportation projects at the federal and state levels such as the TIFIA and airport access projects and state-based credit assistance programs.

TIFIA and Airport Access Projects

The Transportation Infrastructure Finance and Innovation Act (TIFIA), created as part of TEA-21 in 1998, allows the U.S. DOT to provide direct credit assistance to sponsors of major transportation projects. TIFIA has been reauthorized under SAFETEA-LU, which is the federal act signed into law in 2005 that continues transportation funding for the next 6 years. The TIFIA credit program offers public and private sponsors of large surface transportation projects three distinct types of financial assistance: direct loans, loan guarantees, and standby lines of credit. To be eligible for TIFIA, the project must be included in a State Transportation Plan and before an agreement is made for federal credit assistance, the project must be in an approved State Transportation Improvement Program.

Requirements to access the TIFIA credit program include

- The entity undertaking the project must submit a project application;
- A credit rating or preliminary opinion letter from a rating agency indicating that the project's senior debt obligations have the potential of being investment grade is required with the application;
- Eligible project costs must equal or exceed the lesser of $100 million or 50% of the amount of federal-aid highway funds apportioned to the state for the most recently completed fiscal year;
- Project financing must be repayable in part or in whole from tolls, user fees, or other dedicated revenue sources; and

- If the project is not undertaken by a state or local government or an agency or instrumentality of a state or local government, the project still must be included in both the State Transportation Plan and an approved State Transportation Improvement Plan.

TIFIA credit assistance, backed by a regional gas tax and rental car fees, helped to complete the financing for a $1.3 billion Miami Intermodal Center designed to improve access to and within Miami International Airport.(*8*)

State-Based Credit Assistance Programs

Several programs are state-directed programs enabled through federal-aid funding. As with any TIFIA project, the best point of contact is the state's DOT.

State Infrastructure Bank

The National Highway System Designation Act of 1995 (the NHS Act) enabled states to capitalize transportation credit assistance banks modeled after wastewater State Revolving Loan Funds. The SIB program provides loans, credit enhancement, and other forms of assistance (such as bond banks) to eligible surface transportation projects. Thirty-nine states participated in the NHS Act pilot. SAFETEA-LU established a new SIB program, authorizing all states, Puerto Rico, the District of Columbia, American Samoa, Guam, the Virgin Islands, and the Commonwealth of the Northern Mariana Islands to enter into cooperative agreements with the U.S. DOT Secretary. After entering into a cooperative agreement, they could then establish infrastructure revolving funds eligible for capitalization with federal transportation funds authorized for fiscal years 2005–2009. Since program implementation and capitalization levels vary from state to state, the best source of information about SIB assistance is each state's DOT.

Section 129 Loan

Section 129 loans allow states to use regular federal-aid highway apportionments (annual funding allocations) to fund loans for projects with dedicated revenue streams. A state may directly lend federal-aid highway funds to toll and non-toll projects that must have a pledge of a dedicated repayment source to secure the loan. Section 129 loans must be paid beginning 5 years after construction is completed and must be completed within 30 years of the date federal funds were authorized for the loan. States have the flexibility to negotiate interest rates and other terms for these loans.

Mixed-Use Developments and Intermodal Centers

A mixed-use development typically provides a number of aviation and other transportation services that use a variety of public and private sources of funding. While the rules governing airports' use of grant monies, PFCs, and airport revenue make this a potentially challenging endeavor, the aggregation of potential airport customers at an offsite location establishes a larger market for an airport access project. In this type of development, the airport and its passengers account for only a portion of the center's overall usage. As such, airport grant funds and airport revenue may only pay for the specific components of the center that exclusively serve airport passengers. Examples of a mixed-use development include an intermodal transportation center; a development in partnership with one or more airlines; or a development in conjunction with the private sector, referred to as a public-private partnership. While the enlarged scope of these projects may be relatively costly compared with a standalone airport access project, the multiple purposes of the facility can generate more customers, as well as potential sources of non-aviation revenue, to fund the project. A good overview of available funds for intermodal projects in general can be found in "Intermodal Transportation: DOT Could Take Further Action to Address Intermodal Barriers."(*9*) Case Study 3 is an example of a mixed-use development at the off-airport station.

CASE STUDY 3

Consolidated Intermodal Transfer Center with People-Mover Connection to Airport

- Miami, Florida: Miami Intermodal Center (MIC), which includes a consolidated rental car facility and 1.45 million sq. ft of developable space (office, hotel, retail, parking)
- Capital Funding, Phase 1:
  - FHWA grants ($165 million)
  - Florida DOT (FDOT) state funds (over $386 million)
  - Florida SIB loan ($25 million)
  - Miami-Dade Expressway Authority ($87 million in toll-backed financing, plus $18 million from Florida's SIB for the SR 836/SR112 connector)
  - Miami-Dade Aviation Department ($400 million for the MIA–MIC connector. Funding source–airport user fees)

The MIC is to be completed in 2011 and will be a transfer point to Miami International Airport (MIA) and other destinations for various rail systems (intercity and commuter); buses (local and intercity); rapid transit; taxis; cruise ships; rental cars; and privately owned vehicles. The MIC is located adjacent to MIA property and will be served by dual light-rail people-movers (i.e., the MIA Mover) that span 1.25 miles. The construction of the MIA Mover is being funded in part by airport revenue, flowing through the Miami-Dade Aviation Department's Capital Improvement Plan. A station on the third level of the MIA terminal will connect the MIA Mover to the terminal's automated walkways. The MIA Mover station at the MIC will be located at the fourth level of the Rental Car Center (RCC) between the RCC's Customer Service Lobby and the Miami Central Station, via an elevated pedestrian walkway.

The rental car companies that serve MIA will operate from a consolidated RCC at the MIC. The RCC is being funded through a TIFIA loan, as well as CFCs currently collected on all rental car transactions originating at MIA. The rental car shuttles that serve the airport will cease service once the RCC is operational—the MIA Mover will connect all rental car customers to the RCC.

When completed, the MIC is expected to reduce congestion on the surrounding highways and the access roads to the terminal. Current estimates are that 30% of current vehicular traffic will be eliminated when the MIA Mover becomes operational. Seventy-five thousand passengers are expected to use the MIC on a daily basis, and 60%of total MIC passengers (45,000) will continue on the MIA Mover to the terminal (these estimates include airport employees).

The project includes a joint development component made up of a public and private ground lease program. The joint development leases are expected to help offset the facility's capital and operating costs and may include hotel, office, retail, and restaurant space.

The MIC has been designated a "major project" by the federal government and is receiving more direct financing coordination and oversight from FHWA than would a typical project. Many partners are involved in this large and complex project, requiring a great deal of coordination. The following are the major funding sources for the MIC, as described on the project website, www.mic.dot.com, in November, 2007:

- Federal TIFIA loans;
- Miami-Dade County/MDAD contributions;
- Transportation funding prioritized by the MPO;
- Miami-Dade Expressway Authority;
- Private-sector contributions;
- CFCs paid by rental car customers;
- Lease revenues paid through extended possession leases on property already acquired;
- Contingent rent to be paid by rental car companies, if necessary; and
- FDOT SIB loan.

If the MIC were to be completed on a pay-as-you-go basis, it would take at least 10 years to complete just Phase 1, based on the funding commitments of the State of Florida, Miami-Dade County MPO and Miami-Dade County. TIFIA loans have allowed the project to be accelerated by at least 5 years.

Summary of Funding Sources

Table 14 summarizes the funding sources described in this chapter that may be available for an offsite terminal and airport transportation link. The project sponsor should also research funding opportunities that may be available in the specific market area in which the airport or offsite terminal is located such as through state, county, or municipal funding sources. Case Study 4 presents a hypothetical example of an approach to researching funding sources for an offsite terminal with a bus link to the airport.

Table 14. Potential funding sources, offsite terminal and airport transportation link.

Project Type	Federal and/or Local Agency	Program Description/Eligibility	Agency Contact(s)
Planning	FAA	Airport master plans and area-wide system plans.	FAA Office of Planning and Programming and Airport District Office
Planning	FHWA and FTA	Projects coordinated through MPOs (areas greater than 50,000 population) and state DOTs (less than 50,000 population).	MPOs and state DOTs
Capital: on-airport portions of project	FAA	"On-airport" transportation and facilities that serve airport passengers. • AIP: priority for grants for airside and terminal needs. • PFCs: use if significant impact on aviation system capacity and congestion reduction. • Airport revenue: eligible.	FAA Airport Financial Assistance Office for intermodal projects involving off-airport links. FAA Airport District Office for financial eligibility
Operating: on-airport portions of project	FAA	Airport revenue may be used to support operations of the on-airport movement of passengers and other operational costs. Off-airport bus routes permitted if service exclusively serves airport passengers.	FAA Airport District Office
Capital: off-airport solutions with passenger processing	TSA	Checked baggage-screening projects that result in more efficient and secure operations.	TSA Federal Security Director responsible for airport
Capital: multi-use facilities with rental car operations	FAA	CFCs: Fees on rental car users that can be leveraged to construct facilities.	FAA Airport District Office
Capital: transit vehicles and facilities	FTA and FHWA (MPOs and state DOTs)	Public transportation buses and fixed-guideway transit projects, including those that are part of regional systems. Non-attainment and maintenance areas eligible for CMAQ monies that provide air quality benefits.	FTA Regional Office and MPO/state DOT
Operating: transit service	FTA	Limited operating assistance available to urbanized areas less than 200,000 in population.	FTA Regional Office and MPO/state DOT
Federal and state credit assistance	FHWA and state DOTs	TIFIA: Loans and lines of credit available for major transportation projects. SIBs: credit assistance available for eligible surface transportation projects.	FHWA Resource Centers and state DOTs

Source: Jacobs Consultancy

CASE STUDY 4

Hypothetical Scenario of Possible Funding Sources for an Offsite Terminal with Connecting Bus Service to the Airport

The case studies in this section have focused on presenting examples of the best uses of currently available funding sources, but these case studies are of existing terminals that do not meet the report's focus on offsite terminals outside of a 10-mile airport radius with a non-stop transportation connection to the airport (the case studies do, however, illustrate the different functions that any offsite terminal may provide). For that reason, this hypothetical case study shows potential funding sources for an existing offsite terminal as if it were being planned and developed today.

For this financing case study the key assumptions are

- The airport operator is the project sponsor.
- The terminal is located 15 miles from the airport. Transportation is provided via diesel-powered motor coaches that use dedicated HOV lanes on the Interstate between the offsite terminal and the airport.
- The offsite terminal provides basic concession services and a waiting area, as well as 1,000 long-term parking spaces for passengers, 20 short-term parking spaces, and 800 parking spaces for airport employees.
- Bus service is direct and non-stop between the offsite terminal and the airport terminal area, ensuring that only airport passengers and employees use the bus service.
- The airport operator leases the offsite terminal from a local real estate company.
- The airport operator has a contractual agreement with a private company to operate the bus service. The private company owns and maintains the buses.
- Currently baggage check-in processes are not performed at the offsite terminal, although they may be in the future.

If this terminal project were under development today, the first step for the airport operator would be to coordinate with the regional MPO. Funding for the required planning studies could be requested from the FAA's Airport Planning and Programming Office.

The FAA's Airport Financial Assistance office would also need to be consulted early in the project development stages in order to review airport revenue and AIP and PFC funding eligibility. The primary question would be whether the lease the airport operator holds to the offsite terminal is of a duration and security level such that the FAA would consider the on-airport and ownership criteria met. If so, PFC eligibility could be established due to the airport roads and curbside congestion relief provided by the bus service. If the airport operator wished to use PFC funds at the $4.50 level for this project, the more stringent "significant contribution" requirement would also need to be reviewed. If all of these criteria are met, the airport operator would have the ability to consider using airport funds on the eligible public, non-revenue-producing areas of the offsite terminal. The airport operator would next explore potential federal funding sources. FTA Section 5307 grants would be explored for terminal development funding. FTA Section 5309 grants may be available to assist in the purchase of low-emission buses.

If the airport is located in a federal air-quality non-attainment area, coordination with the MPO for potential CMAQ funds would also be explored. The airport operator's focus on reducing single-occupancy-vehicle trips and the associated emissions reductions would make the parking facility at the offsite terminal eligible for CMAQ funds.

After exploring the grants listed above, the airport operator would develop the financing plan most appropriate for their organization. This may include the use of airport revenue, bonds, and/or the other federal and state credit assistance programs listed previously.

CHAPTER 7

Branding, Advertising, and Customer Service

It is important to create a branded product that the customer will be aware of, understand, and remember easily. Potential customers must understand the benefits of using the offsite terminal and transportation link compared with the convenience of using currently accepted airport access modes. Some market segments will be easier to reach than others, and strategies should be developed accordingly. Knowing the customer segments the offsite terminal is likely to serve and marketing the service accordingly are crucial to service development and ultimate success. Providing excellent customer service is also important in building a loyal customer base.

Branding

Naming the offsite terminal and transportation link, creating a look for the vehicles, and incorporating the brand into signage and information dissemination are all part of building brand awareness. Even if the project sponsor intends to offer only one offsite terminal, the brand should be created so that it can extend to additional terminals in the future. The success of the offsite terminal and transportation link also depends on how the service is operated from the airport. The bus should pick up from each airport terminal in a prominent location so that air passengers understand where to board the next departing bus when they exit the terminal.

Brand Identification and Reinforcement: LAX FlyAway and Logan Express Buses

The Logan Express program serving Boston Logan International Airport and the LAX FlyAway program serving Los Angeles International Airport provide two examples of how branding has been undertaken. Buses on each of the four Logan Express routes have an identical design, but are painted different colors for each destination. Buses on each FlyAway route have an identical design and are painted in the same colors, with wording on the bus denoting the destination. At both airports, the brand name of the bus is clearly indicated with signage at the designated pick-up area of the terminal curbs. In effect, each Logan Express bus and LAX FlyAway bus making the loop of airline terminals and traveling throughout the region is reinforcing the brand identification that benefits all the services bundled under one umbrella.

Signage at the offsite terminal is another form of branding and advertising. Signage denoting the presence of the offsite terminal and transportation link should be placed prominently at the offsite terminal so that passers-by are made aware of the terminal. If the terminal is visible from the highway, signage should be prominent for highway users. Wayfinding signage should also be placed on routes leading to the offsite terminal and highway exits.

Public Information

Information should be easy to obtain for travelers in search of transportation options or for those who have heard about the service. Information on location, schedules, fares, parking, and other relevant details should be provided in a prominent place on the airport website. If parking availability at the offsite terminal is a concern, real-time information should be provided to the customer on the status of the parking supply. A toll-free telephone line should also be provided to customers, preferably with numbers that can be spelled out in an acronym for customers to remember.

If there is an online trip planner provided by the regional transportation system or another sponsor, the remote terminal and airport transportation link should be integrated into the database. If the offsite terminal and transportation link is in proximity to other modes, the sponsoring organization should coordinate with the responsible transportation providers to ensure that all customers have access to information that enables them to make connections between the airport transportation link and the other modes.

Los Angeles Metro's Regional Trip Planner

The Los Angeles County Metropolitan Transportation Authority (Metro) website offers a regional trip planner that provides travelers with individualized trip routing via public transportation within the region. Metro is the largest transit provider in Los Angeles County. Its trip planner incorporates route information on public transportation provided by all public transportation providers in the county. The LAX FlyAway is integrated into the system. In addition, the commuter rail provider, Metrolink, and Amtrak customer service representatives are trained to inform their passengers about FlyAway service when they are traveling to LAX.

Public information announcements on the radio during heavy travel periods, on local cable stations, and in publications will boost awareness of the offsite terminal and transportation link. Public interest articles related to the offsite terminal and about the users of the offsite terminal and transportation link will attract potential customers. Additionally, promotions commemorating milestones—an anniversary of the facility or the 100,000th customer—will attract media attention to the offsite terminal.

Advertising—Communicating with Target Markets

Resident Traveler

The airport associated with the offsite terminal is the home airport for the resident traveler. Public relations, advertising, and marketing efforts can be geared toward this market using media such as local papers, radio stations, billboards, travel fairs, public events, and public information advi-

sories. By employing these methods at service launch and through an ongoing advertising program, resident air travelers will become aware of the services through the information provided and by word of mouth. For offsite terminals located in suburban markets, the primary customer is the resident traveler, so this type of advertising will reach the majority of the target market.

The Importance of Word-of-Mouth Advertising

The power of word-of-mouth as a way of drawing positive or negative attention to a product should not be underestimated. Logan Express surveys indicate that although many Logan Express travelers have been exposed to advertisements, they were also made aware of the service by an acquaintance.

Non-resident Traveler

The challenge of familiarity is different for the nonresident traveler. Prior to entering the region the airport serves, nonresident travelers are dispersed throughout the nation and the world. Other than information provided on the airport website or telephone line, there is not an efficient and cost-effective way to disseminate information to nonresident travelers. For the nonresident customer, particularly U.S.–based customers, awareness of airport transportation options outside the home city is generic: taxi, door-to-door shuttle, and subway.

Repeat customers of the airport will eventually learn about the offsite terminal and transportation link in a variety of ways such as seeing the buses, seeing the advertisements targeted to residents, or by word of mouth. An offsite terminal located with intermodal connections is more likely to be used by nonresident travelers who are using the public transportation system versus the offsite terminal that does not offer public transportation connections. A further challenge of capturing the nonresident market exists with customers whose egress mode from the airport is also their transportation mode while visiting—those customers using a rental car. Unless there is an incentive for this customer to use the offsite terminal and rent a car there, the customer will choose to pick up the rental car at the airport.

Some methods for disseminating information to non-residents include

- Working with convention and visitors bureaus and travel and tourism offices to provide information on the offsite terminal to its customer base;
- Distributing information on the offsite terminal to publishers of travel books, travel websites, and articles published in newspapers and magazines in other parts of the United States and the world;
- Providing offsite terminal information to the airlines for inclusion in articles about the region for in-flight magazine publication;
- Providing advertising and in-terminal announcements on the service in areas of the terminal that serve deplaning air passengers;
- Providing brochures on the service in the area of the terminal that provides regional access options from the airport; and
- Exploring ways to automatically disseminate information about the offsite terminal to passengers purchasing airline tickets to the airport served by the offsite terminal.

Airport Employees

For offsite terminal markets that have the potential to attract a significant number of airport employees, the project sponsor should promote the service to as much of the airport employee

population as possible. Viable methods for doing this will vary by airport, but may include contacting all employers and providing information for distribution to employees; sending out information to security badge holders or parking permit holders; and advertising in an employee cafeteria, in an on-airport newsletter, or in employee shuttle buses.

Customer Service

All methods of contact for customers needing information on the offsite terminal and transportation link should be easy to use, informative, and stress-free. The offsite terminal will only be successful if it develops a loyal customer base: satisfied customers will recommend the offsite terminal to other potential customers. Some considerations include

- Staff at the offsite terminal, bus operation, and representatives at the airport providing information on ground transportation options should be trained to promote a positive customer experience by emphasizing customer service with a friendly and helpful attitude.
- Information on a website should be straightforward, easy to locate, and laid out in a concise format and should anticipate frequently asked questions.
- An easy to follow procedure for reporting and claiming lost and found items should be established for customers.
- A method for obtaining customer feedback should be provided.
- The setup of an automated telephone line should streamline the decision tree the customer is subjected to for obtaining typical information such as terminal location, hours of operation, frequency, and fare:
  - Recorded information should be provided in all commonly used languages and
  - A method for reaching a live person in case of emergency should be provided.
- Procedures should be in place to assist customers with disabilities.

Information Technology

Information technology can be used to increase awareness of the offsite terminal or improve customer service. With advancing information technology, sharing real-time information about actual bus departure times will become easier and more universally assumed in the marketplace. Providing actual bus departure times and actual parking space availability to drivers on the major feeder routes will become more commonplace. Information now available on computer screens via the Internet will become universally available on cell phone screens, making the task of providing local service information even easier.

For an airport with multiple terminals, "next-bus technology" may be helpful in retaining customers. The concept is that transponders on the bus are linked into a system that estimates the time the bus will arrive to pick-up passengers at specific locations. Arrival times are transmitted to the pick-up locations and displayed on a computerized panel. Since the departing schedule will be valid for the first terminal, this type of information allows passengers at remaining terminals to know when the next bus will arrive and alleviates worry about having missed a bus. Since the deplaning passenger has already taken a potentially lengthy flight and is anxious to reach their final destination, next-bus technology allows the passenger to relax at the terminal curb while waiting for the bus, promoting a positive customer experience.

In the future, opportunities may exist to integrate flight information systems with airport ground access information. Kiosks providing ground access information may also provide flight departure and arrival information.

CHAPTER 8

Implementation Guidelines

The planning and implementation of an offsite terminal and transportation link requires the participation of individuals with expertise in areas that may include transportation planning, environmental regulations, law, advertising/public relations, finance, accounting, facilities planning, real estate, operations, parking, risk management, government relations, architecture, design, and security. A project manager should be designated to work with the property owner and other outside parties and as a point of contact and coordination for all activity within the project sponsor organization. Key members of the team should communicate and meet on a regular basis to keep the project flowing smoothly.

The following is a basic checklist of work items required to implement an offsite terminal and airport transportation link. The project sponsor will assign estimated times and resources to the tasks to determine the overall timeline for a project and the interdependency of tasks. The following assumptions are made:

- Market analysis and ridership forecasts have been completed.
- A property in the market area has been identified for the offsite terminal:
  - Project sponsor is in negotiations with property owner and
  - Property zoning allows for this type of use or can be changed to meet project deadlines.
- Facility needs have been defined: project design has been completed and construction schedule has been determined.
- Required environmental and traffic studies have been identified, subject to successful negotiations with the property owner.
- Appropriate funds have been allocated for the project.
- Service characteristics of transportation link have been defined—hours of operation, frequency, fare, and vehicle type.
- Method for providing transportation link has been determined—self-operation, third-party operator competitive bid, or concession.

Negotiation of Terms of Agreement

In addition to typical terms that are developed for the purchase or lease of a property, key considerations in developing an agreement to lease or purchase a property for an offsite terminal include the following:

- **Revenue diversion**—if the project sponsor is an airport operator, terms of agreement cannot result in actions that would be considered revenue diversion. Examples that should be scrutinized include the requirement for a project sponsor to make a capital investment with a life longer than the proposed lease term or revenue sharing with the property owner.

- **Length of lease/option to purchase**—if the location selected for the offsite terminal proves to be successful, it will be undesirable financially and from a customer-service perspective and may be impossible due to land availability to relocate the offsite terminal. For short-term leases, the project sponsor should negotiate terms of renewal so that property is available if the offsite terminal is successful and the renewal rents can be planned for. A long-term lease should be negotiated with a favorable early termination provision with an option to purchase the property.
- **Control of document**—during negotiations, one party should have control of the document, preferably the project sponsor.
- **Payment terms**—payment terms required by the property owner should be compatible with the accounting system of the project sponsor.
- **Liability and insurance**—terms should be acceptable to the project sponsor. If the transportation link is operated by a third-party operator, the responsibilities of each party should be clearly defined.
- **Flexibility/exclusive use of lease area**—if the land for the offsite terminal is leased, the lease should not be restrictive in terms of uses that can be added to the property if the uses meet zoning requirements. For example, if the project sponsor decides to add revenue-generating businesses to the offsite terminal at a later date or sublease a portion of property allocated for future terminal or parking expansion, the project sponsor should have the ability to do so without having to pay the property owner monies in addition to the lease payment. The project sponsor should have exclusive use of the leased area. For example, the project sponsor should be the only entity that can place advertising on the leased area.
- **Mitigation**—if mitigation is required on or in the vicinity of the offsite terminal, establish parties responsible for mitigation.
- **Inspection**—the project sponsor should pay for independent inspections of the property, as well as a title search. In addition, the project sponsor should be aware of any easements on the property.
- **Facility development**—if the property owner is developing the facility, the project sponsor should require warranties and specific details of what will be provided.
- **Shared space**—if the offsite terminal is co-located with other uses, exclusive spaces, shared spaces, and related liability should be defined.
- **Environmental studies/environmental impact report**—if the results of environmental studies may render the project infeasible or if the project sponsor cannot enter into an agreement until proper environmental clearances have been obtained, securing a commitment may be difficult for both parties since neither will want to be at risk to conduct the studies. If the property owner agrees to finance the studies, the owner will be at risk during this time for the cost of the studies and for the time and foregone revenue when the property was not available to other potential buyers or tenants if the project sponsor doesn't commit to the property. Working this out can be challenging and may be resolved with some type of contingency agreement or memorandum of understanding.
- **Competition**—the project sponsor should consider requiring the property owner to agree not to develop or lease property to be used for an airport transportation link within a certain radius of the location of the offsite terminal.

Timeline Development

Develop a timeline for the opening of the offsite terminal. For all major tasks, identify dependencies between tasks, time for completion, and responsible parties. Items include the following:

- Project sponsor's internal approval process for all project items such as funding allocation, solicitations to conduct studies, construction contracts, lease approval or transfer of ownership, bus operation, and acquisition and installation of technology and furniture.

- Property negotiations, executed lease agreement or transfer of ownership, and occupancy date.
- Conduct of environmental studies and related approvals.
- Zoning changes.
- Permits and other approvals from outside parties.
- Facility development and provision of mitigation: design, construction, and opening of the terminal, parking, and access; mitigation to prepare property; and mitigation related to project impacts.
- Transportation link development: acquisition of and preparation of vehicles, hiring/training of personnel, fare-collection technology, or competitive bidding process for third-party operator or concession agreement.
- Development and execution of advertising and public-relations plan:
  - Advertising and public information to launch service, which should begin at least 2 months prior to opening day;
  - Ongoing advertising; and
  - Provision of a telephone information line and online information.
- Coordination with other transportation agencies.
- Develop plan for opening day including invitations for guests and media, where event will be located, who will speak, security, and how to attract passengers for terminal use during the event.
- Signage plan and installation for offsite terminal, access points in the vicinity of the terminal, highway exits, and wayfinding at airport.
- Security plan.
- Establishment of internal accounting and reporting procedures.

Transportation Link

Work tasks related to introducing the transportation link include the following. Items will be added and subtracted to this list, depending on the project:

- Determination of how transportation link arrivals and departures on airport curbs impact curb operations.
- Fare-collection method for offsite terminal and airport terminals:
  - Machines and/or agents and
  - Cash, credit cards, and tie-in to transit system.
- Staging area for buses at offsite terminal (facility issue).
- Restrooms for bus drivers (facility issue).
- Determination of whether luggage porters are necessary to assist with loading and unloading baggage.
- Prepare bus operation:
  - If self-operated,
    - Hire and train staff,
    - Acquire or lease vehicles,
    - Prepare vehicles and conduct test runs of routing, and
    - Develop alternative routings for congested periods and emergency situations.
  - If operated by a third-party or concession,
    - Develop solicitation materials,
    - Include items listed above for self-operation and conduct solicitation, and
    - Establish service start date of transportation link, which will be determined by the bidding and selection process.

Offsite Terminal Facility Preparation and Capital Improvements

Work items related to the development, construction, and mitigation of the offsite terminal and parking are as follows:

- Conduct studies related to operations, impacts, and mitigation such as environmental studies and traffic studies.
- Obtain necessary permits for site preparation, construction, and operation.
- If zoning changes required, complete application process.
- Construct terminal and parking.
- Coordinate arrival and installation of equipment, furniture, and finishes with construction schedule.
- Activate communication lines and other utilities and test functionality prior to opening day.
- Develop and install signage in the terminal, at the parking area, at the property entrance, and on the property.
- Arrange for the installation of wayfinding on local roads and highway exits.
- Take necessary steps for implementation of mitigation measures on site and in site-impacted area.

On-Airport Facility Preparation

The following are on-airport work items related to accommodating the transportation link and passenger wayfinding:

- Designate loading and unloading zones at departure and arrivals curbs because, ideally, the transportation link will pick-up and drop-off at all air passenger terminals;
- Develop and install signage inside terminal and at curb areas for customer wayfinding; and
- Designate vehicle layover area on-airport or near the airport.

Develop Pro Forma and Scenario Analysis

Pro forma and scenario analysis tasks are as follows:

- Develop pro forma to estimate the financial performance of the project; ideally, this is done prior to implementation.
- Use pro forma to test scenarios such as fare levels, parking rates, different facility plans, and bus-service levels.
- Refine pro forma as project progresses.

Advertising, Branding, and Public Information

To develop a program that will create awareness of the offsite terminal far enough in advance that passengers will plan to use it for flights taken beginning on opening day, branding, advertising, and public information campaigns should be completed. The tasks are as follows:

- For branding, develop a brand identity for bus and terminal that will be incorporated into advertising and signage.
- For advertising,
  - Develop an advertising campaign for launching the offsite terminal and transportation link and
  - Develop an ongoing advertising program to continue to build awareness and customer base.

- For a public information campaign,
  - Brief representatives who provide information to air passengers at the airport and on telephone lines with details of the offsite terminal operation and provide them with published materials.
  - Issue press releases related to the service prior to opening day, on opening day, and on an ongoing basis.
  - Coordinate with regional and local transportation agencies, chambers of commerce, convention and visitors' bureaus, libraries, universities, community groups, and other organizations to make them aware of the offsite terminal and for coordination with their public information efforts.
  - Provide a telephone line providing information on the service.
  - Provide information on project sponsor website.

Communication

The following tasks should be completed to ensure good communication:

- Establish communication protocol among parties from opening day and beyond:
  - Project sponsor and property owner,
  - Project sponsor and bus operator,
  - Bus operator and property owner,
  - Security/law enforcement personnel and all parties, and
  - Communication protocol during emergencies.
- Procedures should be put in place for
  - Customer emergencies,
  - Lost and found items, and
  - Customer feedback.

Security Plan

Develop security plan, including entities having jurisdiction on offsite terminal and on the route for the transportation link.

Project Sponsor Approval Procedure

The implementation plan should include project briefings, reporting requirements, and approval procedures necessary within the project sponsor organization and for outside parties.

Accounting

The following are accounting-related tasks:

- Establish cost centers or other accounting procedures to track costs and make payments;
- Determine how to charge cost of time spent by project sponsor administrative staff on offsite terminal and transportation link issues to the project financials; and
- Assign responsibility for comparing actual costs and revenues with projected financial performance.

CHAPTER 9

Performance Monitoring

During the planning stages of the offsite terminal and transportation link, thought should be given to what kinds of reports to produce to measure performance and which tools and methods are needed to collect the data. This may influence elements of the project development process—for example, the decision to acquire parking revenue–control equipment or bus fare–collection equipment may be dictated by data needs. The following categories encompass representative benchmarks the sponsoring organization may want to monitor, to disseminate information about, and to use as a basis for adjustments and improvements.

Goals and Objectives

It was recommended in Chapter 2 that goals and objectives should be developed in the early stages of the project to assist with project development and as a way for evaluating success once the offsite terminal and transportation link is operational. The sponsoring organization should determine (1) what kinds of measurements are necessary to report progress toward goals and objectives and (2) the reporting mechanisms to produce for various audiences. Audiences may receive reports with differing levels of detail—for example, operations personnel require certain data in greater detail than what is needed by executives. Reports internal to the sponsoring organization will be different than transmittals to public interest groups or members of the media.

Finance

The category of finance includes reports that present financial performance compared with goals, budget projections, and previous performance. In addition to breaking out costs, revenues, and overall performance, measurements can be developed that present financial data in relation to other performance measures, such as

- Cost, revenue, or overall performance per passenger or per seat (transportation link);
- Costs per bus-mile traveled;
- Costs or overall performance per net vehicle trips saved, per net VMT saved, and per emissions saved;
- Hourly service costs of the transportation link; and
- Costs, revenue, and overall performance per parking space.

User Statistics

User statistics include reports on utilization of the transportation link and parking facility. Essential statistics include ridership on the transportation link by ridership category compared with previous periods and compared with projections. Reports may also include aver-

age load per bus and peak and off-peak periods for the transportation link based on the highest and lowest ridership periods. The number of instances in which a bus was full and could not serve all passengers must also be monitored to determine the best corrective measure for the future.

Air passenger and employee ridership can be compared with the number of passengers in the market area of the offsite terminal and the number of employees in the market area to determine the market penetration of the offsite terminal and transportation link. Ridership patterns can be compared with the airline seat distribution, considering lead times to get to the airport and through security for the flight, and lag times for leaving the airport with or without checked luggage. Information from various reports can be used to determine whether schedule adjustments are necessary, particularly if service needs to be added at busy times. If data indicates that some peak times at the airport are not also peak times on the bus, further analysis can be done to determine the composition of passengers to determine whether additional marketing may attract more riders.

Data that will be useful for evaluating parking performance includes number of entrances and exits by day, the distribution of exits by length of stay, the average length of stay, vehicle occupancy, and average ticket price. This data can be compared with on-airport parking statistics to determine whether parking patterns are similar. It should also be compared with ridership on the transportation link. The project sponsor should try to segregate employee and passenger parking data. Parking statistics will assist the project sponsor in determining how capacity is meeting demand, when to plan for additional capacity, and how to prepare for peak periods. If there is a short-term parking area, occupancy should be monitored to determine whether the supply is sufficient.

Operational Performance Measures

Operational performance measures report on service efficiency and quality of service. Reports in this category include trip times and average trip times; on-time performance statistics; maintenance statistics for vehicles; and employee performance, retention, and absences. Transaction time per ticket sales may also be important if it affects on-time performance of the bus or the passenger's ability to board the next bus.

Mitigation

The offsite terminal and transportation link reduces the impacts of low-occupancy trips that otherwise would have been made to the airport. Information on reduced vehicle trips, emissions savings, and savings in VMT are useful for reporting progress and promoting the benefits of the offsite terminal and transportation link within the sponsoring organization, to community groups, to environmental groups, and to elected officials.

Surveys

Survey data can provide information on ridership demographics, passenger receptiveness to changes in service, fares and amenities, passenger satisfaction, and effectiveness of advertising. Surveys conducted while the service is new and growing are important to understand how the service is developing and to determine ways to boost ridership. Surveys are also important once ridership has reached maturity to track trends, to monitor changes, to determine how to retain

customers, and as valuable information for planning additional offsite terminals. Types of surveys are as follows:

- **Market/demographic surveys**—at a minimum, collect information on trip origin; place of residence; purpose of trip; length of stay; number of passengers in travel party; access mode to offsite terminal (including pick-up/drop-off versus long-term parking); how the passenger would have gotten to the airport if the offsite terminal was not available; and how the passenger heard about the offsite terminal. The survey could also ask the number of trips during the year that were taken for business or pleasure and the number of times the offsite terminal was used. It could also be used to ask basic questions about service or fare changes or amenity offerings at the offsite terminal. This type of survey is best administered on the bus, where passengers have time to fill it out.
- **Customer satisfaction surveys**—surveys that rate the quality of service for various aspects of the offsite terminal experience such as the transportation link, parking, customer service, and information availability.
- **Advertising effectiveness surveys**—passengers could be queried using a dedicated survey instrument or as part of a market/demographic survey or customer satisfaction survey. If the project sponsor would like more detailed information on a current or recent advertising program or opinions on proposed advertising, focus groups may be effective. Focus groups with resident air passengers or airport employees who live in the market area or random surveys of air passengers at the airport can also be used to reach airport users that are not currently using the offsite terminal and transportation link. Information from the focus groups and surveys will help determine their awareness of the offsite terminal and related advertising and the reasons they are not using the offsite terminal.
- **Airport surveys**—questions about use or awareness of the offsite terminal and transportation link could be included in surveys that are administered at the airport such as O/D surveys, surveys conducted for a specific study, or customer satisfaction surveys.

Customer Feedback

Comment cards and the project sponsor's website should be available for customers to report feedback on the service. The project sponsor should define a turnaround time for investigating complaints and following up with customers: corrective actions to customer complaints may lead to service improvements. Positive feedback may provide input for future advertising of the service while providing positive reinforcement for employees and decisionmakers.

References

1. 49 U.S.C. 47101(5).
2. 49 U.S.C. 47101(g)(2).
3. *ACRP Synthesis of Airport Practice 1: Innovative Finance and Alternative Sources of Revenue for Airports,* Transportation Research Board of the National Academies, Washington, DC (2007).
4. *Airport Improvement Handbook (AIP Handbook),* Order 5100.38C, FAA, effective date June 28, 2005; p. 47.
5. *Airport Improvement Handbook (AIP Handbook),* Order 5100.38C, FAA, effective date June 28, 2005.
6. *ACRP Synthesis of Airport Practice 1: Innovative Finance and Alternative Sources of Revenue for Airports,* Transportation Research Board of the National Academies, Washington, DC (2007); pg. 35.
7. Statutory requirements governing revenue use are found at 49 U.S.C. 47107 and 47133.
8. FHWA. *Innovative Finance Brochure—Credit Assistance,* FHWA, Washington, DC (2006).
9. "Intermodal Transportation: DOT Could Take Further Action to Address Intermodal Barriers." (*9*) GAO-07-718, United States Government Accountability Office Report to the Chairman, Committee on Transportation and Infrastructure, House of Representatives, June 2007.

APPENDIX

Transit Air Benefits Calculator: Description and User's Manual

Air Pollutants

To conduct a simple evaluation, one often looks at the "criteria pollutants." These pollutants—defined by the Clean Air Act—include oxides of nitrogen (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), ground-level ozone (O_3), particulate matter (PM), and lead. Following is a description of the criteria pollutants and other significant pollutants.

Oxides of Nitrogen

NO_x cause respiratory problems and contribute to ozone formation, acid rain formation, nutrient overloading of lakes and streams, regional atmospheric haze, and global warming.

Ozone

Ozone is primarily formed through a chemical reaction involving sunlight, NO_x, and volatile organic compounds (VOCs). Motor vehicles are the largest source of NO_x and the second largest source of VOCs, accounting for 36% of all NO_x and 22% of all VOCs emitted nationally.[1] Ozone is linked to a variety of respiratory problems including lung irritation, wheezing, coughing, difficulty breathing, aggravated asthma, and reduced lung capacity.

Particulate Matter

PM is a term referring to small, respirable particles in solid and liquid form. PM can be composed of any number of materials including dust, organics, metals, and acids. Smaller, fine particles are more toxic than larger ones because they can be inhaled deeper in the lungs and absorbed in the bloodstream instead of being exhaled. Buses emit a greater portion of smaller or fine particles than do motor vehicles. About 50% of PM from cars is considered fine (i.e., less than or equal to 2.5 micrometers, or "$PM_{2.5}$"); about 90% of diesel particulate (from buses) is fine.[2] Highway vehicles[3] generate about 1% to 3% of all particulate matter.

[1]Source: U.S. EPA data for 2006, www.epa.gov/ttn/chief/trends/trends06/nationaltier1upto2006basedon2002finalv2.1.xls as of October 2007.

[2]Based on National Mobile Inventory Model (NMIM) output for Burlington, VT, 2008 model run.

[3]Source: U.S. EPA data for 2006, www.epa.gov/ttn/chief/trends/trends06/nationaltier1upto2006basedon2002finalv2.1.xls as of October 2007.

Oxides of Sulfur

SO_2 is generated primarily by electric utilities. With fuel sulfur standards dropping to 15 ppm, very little is generated by highway vehicles (about 1%).[4] SO_x compounds contribute to acid deposition, create atmospheric haze, and can cause respiratory illness, especially in children and the elderly.

Carbon Monoxide

CO has many side effects because it displaces oxygen in the bloodstream. As a result, it can cause dizziness, affect the central nervous system, affect people with heart disease, and contribute to smog. Oxidation catalysts have reduced highway vehicle CO emissions by 66% since 1970 despite the large increase in VMT over that time period.[5] As a result, only three cities in the United States are in non-attainment for CO.

Lead

Lead damages the kidneys, liver, brain, and nervous system; causes heart disease; and can last a long time in the environment. Lead was a serious concern when the 1970 Clean Air Act was established. Consequently, a phase-out of lead in gasoline was initiated. Since that time, overall lead emissions from motor vehicles have been virtually eliminated.

Air Toxics/Hazardous Air Pollutants

There is another category of pollutants called "air toxics," also referred to by the U.S. EPA as hazardous air pollutants (HAPs). These are known to or suspected in causing cancer or other serious health effects such as birth defects, respiratory disease, immune system defects, neurological problems, and other problems through chronic and/or acute exposure. There are no federal limits to air toxics concentrations in ambient air; however, many states have adopted their own standards. According to the U.S. EPA, motor vehicle air toxics are expected to decline by 75% between 1990 and 2020 due to the introduction of reformulated gasoline and tailpipe emission limits.

Greenhouse Gases

Greenhouse gases are a separate category of pollutants that contribute to global warming. Commonly known greenhouse gases are water vapor, carbon dioxide, tropospheric ozone, nitrous oxide, and methane. Motor vehicles directly emit or contribute to the creation of each of these greenhouse gases. Water vapor and carbon dioxide emissions are a function of vehicle fuel efficiency, while nitrous oxide and methane are functions of both fuel efficiency and combustion method (e.g., diesel or spark ignition). For example, buses have seven times the carbon dioxide emissions of cars/light trucks[6], but about 10% of the nitrous oxide and 3% of the methane emissions per mile.[7]

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[4]Source: U.S. EPA data for 2006, www.epa.gov/ttn/chief/trends/trends06/nationaltier1upto2006basedon2002finalv2.1.xls as of October 2007.

[5]Source: U.S. EPA data for 2006, www.epa.gov/ttn/chief/trends/trends06/nationaltier1upto2006basedon2002finalv2.1.xls as of October 2007.

[6]2008 NMIM model runs for Burlington, VT.

[7]"Update of Methane and Nitrous Oxide Emission Factors for On-Highway Vehicles," U.S. EPA, EPA420-P-04-016, November 2004.

State Implementation Plans

As noted previously, VOCs and NO_x are ozone precursors and also contribute to atmospheric haze. While there are National Ambient Air Quality Standards (NAAQS) that limit concentrations of criteria pollutants in ambient air, there are also often limits established for NO_x and VOC emissions in certain regions due to non-attainment of ozone standard(s). These limits are set in State Implementation Plans (SIPs).

SIPs are regulations, adopted by a state and approved by the EPA, that establish a plan to meet requirements of the Clean Air Act. In particular, for large metropolitan areas, SIPs may contain emissions budgets, transportation conformity requirements, and limits on industrial sources. "Transportation conformity" refers to a set of rules that requires the transportation system and transportation plans to meet the requirements of the SIP. Transit systems and bus retrofits are often part of a region's transportation plan and are used to meet emissions reduction budgets specified in SIPs. Emissions reductions that are credited must be quantified using methods and models approved by the U.S. EPA.

Transit Air Benefits Calculator

The Transit Air Benefits Calculator, a spreadsheet program, was developed by the project team to estimate the change in various air pollutants and overall air pollution resulting from the airport transportation link serving an offsite airport terminal. It calculates emissions of 40 pollutants from cars, pickup trucks, SUVs, and buses for 24 cities between the years 2006 and 2028. It also aggregates pollutants to assess the net change in overall non-cancer health risk and greenhouse gas emissions.

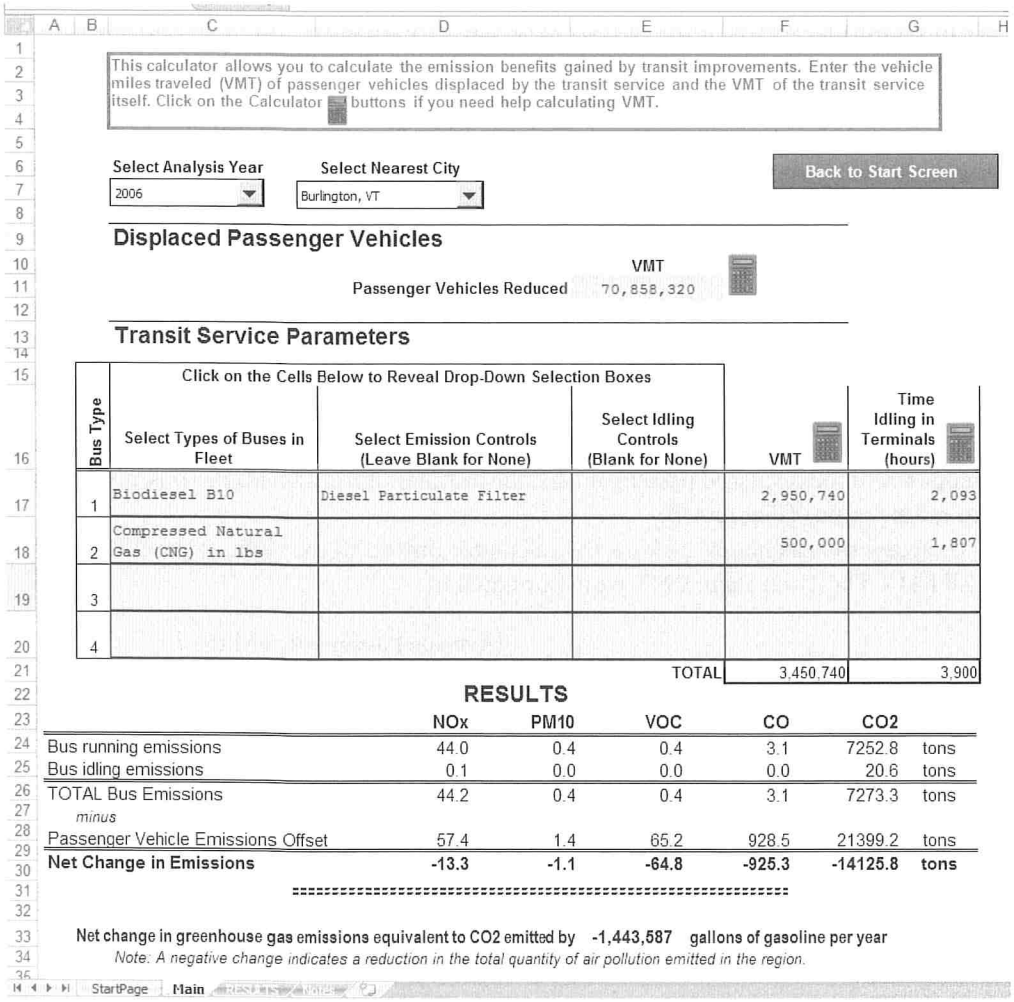
When first started, an opening screen is displayed (see Figure A-1). This shows the user the project name and the funding source. On the initial screen, the user clicks on the start button to move to the main calculations page.

Figure A-1. Transit benefits calculator start page.

The Main calculations sheet has portions which accept user inputs (shaded in gray) and the results (Figure A-2). The process for running a scenario is as follows:

1. **Select an analysis year**—the user can select 2006, 2007, or any other even year from 2008 to 2028. The analysis year is used to take into account reductions in emissions due to retirement of older, dirtier vehicles in the fleet.
2. **Select the nearest city**—the calculations of bus and car/light truck emissions are based on runs from the U.S. EPA's National Mobile Inventory Model (NMIM), which, in turn is based on the U.S. EPA's Mobile6.2 motor-vehicle emissions model. Different cities and counties have different emission rates due in part to
   - Temperature and humidity,
   - Gasoline formulation and vapor pressure,
   - Inspection/maintenance programs,
   - Anti-tampering programs, and
   - Fleet-vehicle-type mix.

   The Calculator considers each of these different factors for each city and computes valid motor vehicle emission rates specific to the county in which the city is located. At present,



This calculator allows you to calculate the emission benefits gained by transit improvements. Enter the vehicle miles traveled (VMT) of passenger vehicles displaced by the transit service and the VMT of the transit service itself. Click on the Calculator buttons if you need help calculating VMT.

Select Analysis Year: 2006 | Select Nearest City: Burlington, VT | Back to Start Screen

Displaced Passenger Vehicles

	VMT
Passenger Vehicles Reduced	70,858,320

Transit Service Parameters

Click on the Cells Below to Reveal Drop-Down Selection Boxes

Bus Type	Select Types of Buses in Fleet	Select Emission Controls (Leave Blank for None)	Select Idling Controls (Blank for None)	VMT	Time Idling in Terminals (hours)
1	Biodiesel B10	Diesel Particulate Filter		2,950,740	2,093
2	Compressed Natural Gas (CNG) in lbs			500,000	1,807
3					
4					
			TOTAL	3,450,740	3,900

RESULTS

	NOx	PM10	VOC	CO	CO2	
Bus running emissions	44.0	0.4	0.4	3.1	7252.8	tons
Bus idling emissions	0.1	0.0	0.0	0.0	20.6	tons
TOTAL Bus Emissions	44.2	0.4	0.4	3.1	7273.3	tons
minus						
Passenger Vehicle Emissions Offset	57.4	1.4	65.2	928.5	21399.2	tons
Net Change in Emissions	**-13.3**	**-1.1**	**-64.8**	**-925.3**	**-14125.8**	**tons**

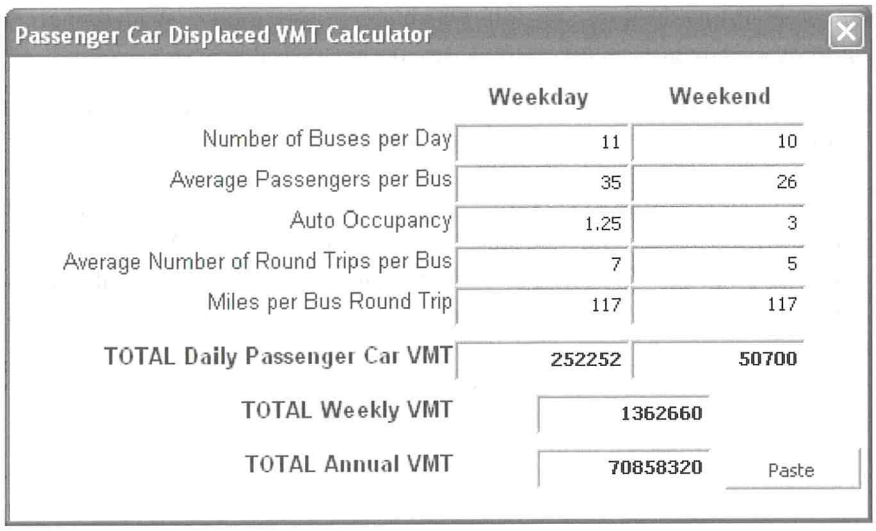
Net change in greenhouse gas emissions equivalent to CO2 emitted by -1,443,587 gallons of gasoline per year

Note: A negative change indicates a reduction in the total quantity of air pollution emitted in the region.

StartPage | Main

Source: Resource Systems Group, Transit Air Benefits Calculator.

Figure A-2. Transit Air Benefits Calculator: main calculations page.



Source: Resource Systems Group, Transit Air Benefits Calculator.

Figure A-3. Simplified displaced passenger VMT calculator.

24 cities in 23 states are represented in the calculator. Note that two cities in the Calculator are in California. NMIM is not approved for use in calculating authorized SIP reductions in California; therefore, results for California should be viewed with caution. California uses the EMFAC model,[8] which is specific to that state.

3. **Enter displaced passenger vehicle VMT**—the VMT for passenger vehicles displaced by the airport transportation link is entered in Cell E11. This VMT may be for an hour, week, month, or year so long as the user uses a consistent unit throughout the worksheet. We recommend the use of annual VMT since emissions are based on the average of January and July Mobile6.2 emission rates. The VMT savings should be calculated using the methodology described in Chapter 6 of this report, taking into account all low-occupancy-vehicle modes including taxi, limousine, private automobile pick-up/drop-off, and private automobile long-term parking. However, if the data is not available for calculating VMT savings at this level of detail, the Transit Air Benefits Calculator includes a simplified VMT calculator method that simply considers the number of buses per day, average number of passengers per bus, the automobile occupancy of the displaced passenger cars, the number of round trips per bus, and the round trip miles per bus (Figure A-3).

   To access the calculator click on the calculator button to the right of the VMT entry cell (Cell E11). The Total Daily VMT would be equal to

$$(\text{Number of Buses per Day}) \times \left[\frac{(\text{Average Passengers per Bus})}{(\text{Automobile Occupancy})} \right]$$

$$\times (\text{Round Trips per Bus}) \times (\text{Miles per Round Trip}).$$

   The Weekly VMT is calculated as follows:

$$(\text{Weekday VMT}) \times 5 + (\text{Weekend VMT}) \times 2.$$

   The Annual VMT is as follows:

$$(\text{Weekly VMT}) \times 52.$$

[8] www.arb.ca.gov/msei/onroad/latest_version.htm as of October 2007.

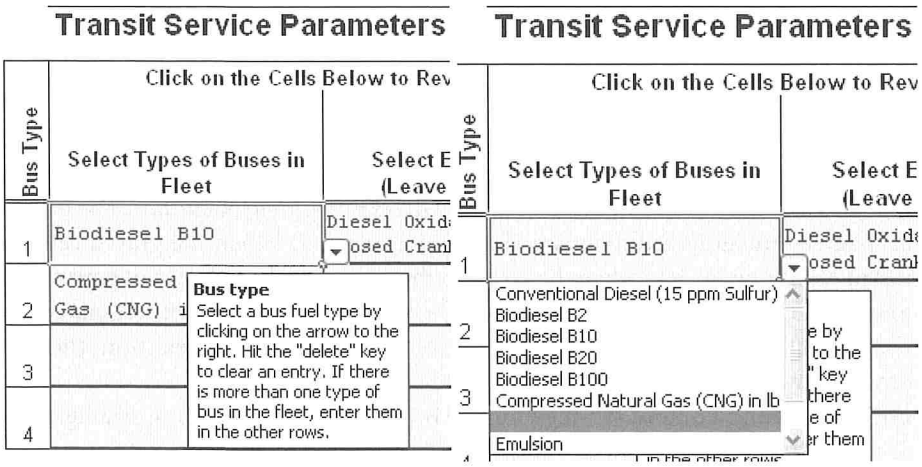
Table A-1. Types of transit vehicles and emissions in the calculator.*

Type of Transit Vehicle	NOx	PM	HC**	CO	CO_2
Conventional Diesel (15 ppm Sulfur)	0%	0%	0%	0%	0%
Biodiesel B2	–1%		2%	1%	0%
Biodiesel B10	–2%	4%	11%	5%	1%
Biodiesel B20	–4%	10%	12%	10%	1%
Biodiesel B100	–10%	37%	69%	40%	5%
Compressed Natural Gas	50%	95%	50%		
Emulsion	15%	20%			

Source: U.S. EPA Diesel Emission Quantifier.

*Values shown indicate the percentage reductions in emissions relative to conventional diesel. Negative values indicate increases in emissions relative to diesel. Missing values are not known and treated as 0%.

**HC = hydrocarbons.



Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-4. Instructions and list of fuel types.

Passenger vehicle emissions are based on emissions from passenger cars and light-duty gasoline trucks, weighted by the actual VMT mix for the chosen city.

4. **Enter the transit service parameters**—the block of cells in grey under Transit Service Parameters allows the user to input up to four different types of vehicles in the bus fleet. For example, if the fleet were made up of 75% conventional buses and 25% compressed-natural-gas (CNG) buses, these two would be entered in separate rows with the VMT allocated proportionally.
   a. **Enter the type of buses in the fleet**—the bus choices available and the associated emissions reductions are based on the U.S. EPA's Diesel Emission Quantifier.[9] The quantifier is an online calculator for estimating the reduction in a fleet of diesel equipment. The quantifier should not be used to calculate emissions reductions to be incorporated into a SIP without first consulting the U.S. EPA Regional Office and SIP guidance documents. The types of transit vehicles modeled are shown in Table A-1. The numbers after "Biodiesel" indicate the percentage of biodiesel in the fuel—for example, B20 is 20% biodiesel and 80% conventional diesel. The list can be accessed by clicking on the cell, then clicking on the arrow to the right of the cell (see Figure A-4). Instructions automatically appear when the cell is

[9]cfpub.epa.gov/quantifier/view/index.cfm as of October 2007.

Table A-2. Emission-control technologies with emissions reductions in the calculator.

Emission Control Technology	NOx	PM	HC	CO	CO_2
Diesel Oxidation Catalyst		20%	50%	30%	
Diesel Oxidation Catalyst + Closed Crankcase Ventilation		25%	40%	30%	
Diesel Particulate Filter		85%	90%	90%	
Diesel Particulate Filter + Closed Crankcase Ventilation		95%	90%	90%	
Diesel Particulate Filter + Lean NOx Catalyst	25%	90%	75%	75%	
Diesel Particulate Filter + Hybrid Electric	50%	95%	90%		
Diesel Particulate Filter + Exhaust Gas Recirculation	40%	90%	90%	90%	
Partial Flow Filter		50%	75%	75%	
Recalibration	25%				
Selective Catalytic Reduction	70%	40%	70%	90%	

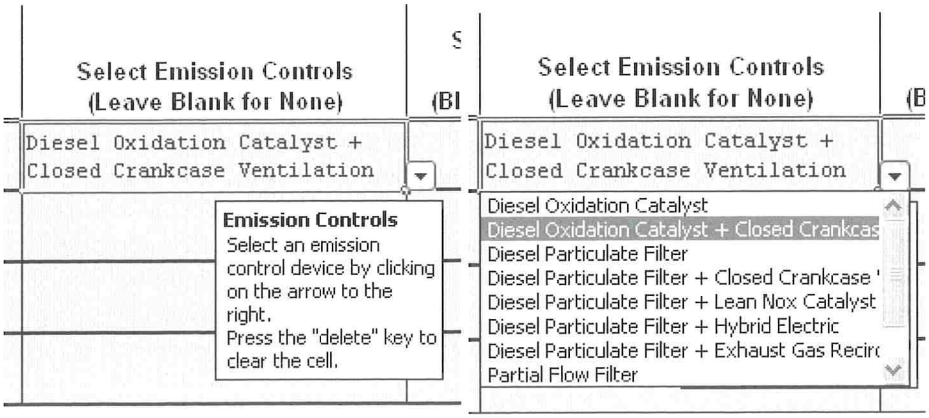
Source: U.S. EPA Diesel Emission Quantifier

clicked (left); the list of fuel types are shown for a given selection when the drop-down arrow to the right of the cell is clicked.

b. **Enter the emissions control technology for the bus**—as above, the emission-control technologies are those found in the U.S. EPA's Diesel Emissions Quantifier. The list with their associated emissions reductions is shown in Table A-2. When the grayed cell is clicked, instructions pop up, and when the arrow to the right is clicked, the list of emission controls to select pops up (see Figure A-5). Emission-control technologies instructions appear when the cell is clicked (left); the list of emission controls are shown for selection when the drop-down arrow to the right of the cell is clicked (right).

c. **Enter the idling-control strategy for the bus**—as above, the idling strategies are those found in the U.S. EPA's Diesel Emissions Quantifier. The list with their associated emissions reductions are shown in Table A-3. If no control strategies are used, the cell can be left blank. The cell instructions and drop-down list are shown in Figure A-6. Idle Control Strategies instructions appear when the cell is clicked (left); the list of strategies is shown for a selection when the drop-down arrow to the right of the cell is clicked (right).

d. **Enter the VMT for the bus type**—enter the VMT of the particular bus type into Column F (see Figure A-7 for instructions). A simplified method for calculating the VMT is available



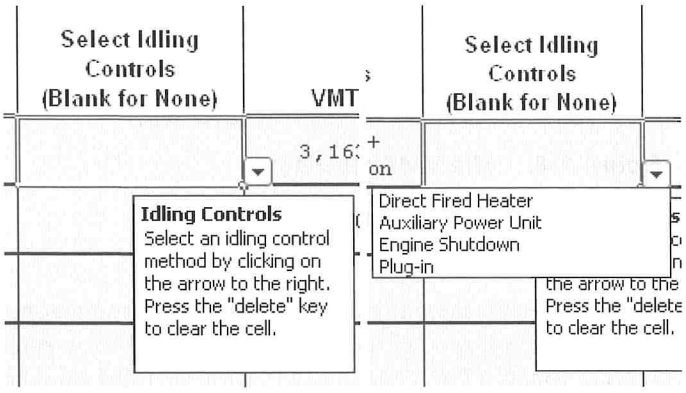
Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-5. Instructions and emission-control technologies.

Table A-3. Idle-control strategies with emissions reductions in the calculator.

Idling-control Strategies	NOx	PM	HC	CO	CO_2
Direct-fired Heater	98%	99%			95%
Auxiliary Power Unit	94%	81%			73%
Engine Shutdown	100%	100%			100%
Plug-in	95%	100%			100%

Source: U.S. EPA Diesel Emission Quantifier



Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-6. Instructions and idle-control strategies.

by clicking on the calculator button to the right of the word "VMT." The calculator, shown in Figure A-8, calculates Annual VMT as follows:

$$\begin{aligned}\text{Daily VMT} = {} & (\text{Number of Buses per Day}) \\ & \times (\text{Average Number of Round Trips per Bus}) \\ & \times (\text{Miles per Round Trip});\end{aligned}$$

$$\text{Weekly VMT} = (\text{Weekday VMT}) \times 5 + (\text{Weekend VMT}) \times 2; \text{ and}$$

$$\text{Annual VMT} = (\text{Weekly VMT}) \times 52.$$

The Bus VMT Calculator estimates annual VMT based on buses per day, round trips per bus, and miles per round trip.

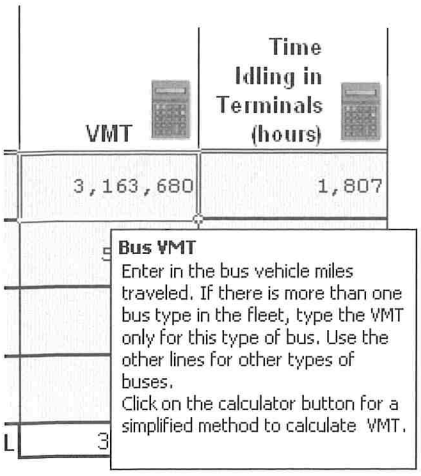
e. **Enter the idling time for the bus type**—the idling time of the particular bus types should be entered in Column F (see Figure A-9 for instructions). However, a simplified method is also available by clicking on the calculator button in the column header. The calculator, shown in Figure A-10, calculates idle time as follows:

$$\text{Daily Idle Time in Hours} = \frac{\begin{array}{l}(\text{Number of Buses per Day}) \times (\text{Number of Round Trips per Bus}) \\ \times (\text{Stops per Round Trip per Bus}) \times (\text{Minutes per Stop}) \\ + (\text{Minutes of Idle during Warm-up and Shutdown})\end{array}}{(60 \text{ minutes/hour});}$$

$$\text{Weekly Idle Hours} = (\text{Weekday Idle}) \times 5 + (\text{Weekend Idle}) \times 2; \text{ and}$$

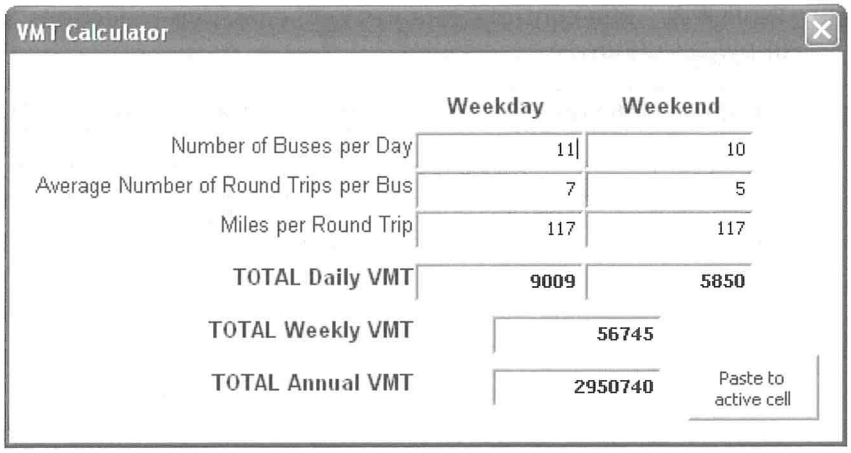
$$\text{Annual Idle Hours} = (\text{Weekly Idle}) \times 52.$$

The idle-time calculator estimates annual idling hours based on the buses per day, round trips per bus, number of stops, idle time per stop, and idling at the garage.



Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-7. On-screen instructions for entering bus VMT.

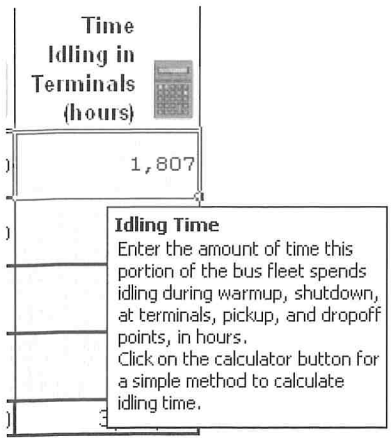


Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-8. The VMT calculator.

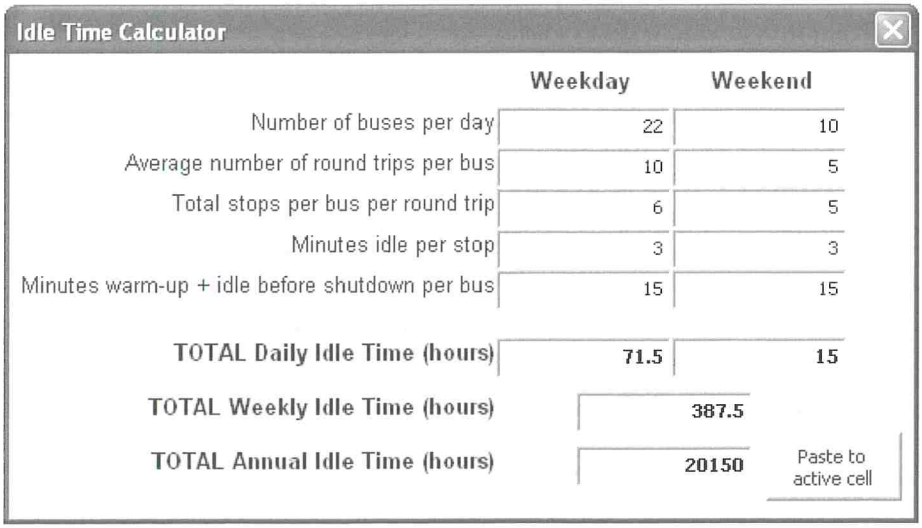
As inputs are entered, the results are automatically calculated. A screenshot of the results is shown in Figure A-11. The first two rows of the table show the total bus-operating and bus-idle emissions in tons for NO_x, PM10, VOC, CO, and CO_2, with the third row showing the sum of the first two rows. The next row shows the tons of these pollutants reduced from the displaced passenger vehicles (cars, pickups, and SUVs). These emissions are based on runs of the U.S. EPA's NMIM model and are based on all roadway types and a default mix of vehicle speeds. Note that emissions improvements due to reduced levels of congestion resulting from diversions to the transit mode aren't taken into account. This can be calculated using other models, but is likely a secondary effect with less impact on emissions than from VMT reductions.

The net change in emissions is shown next. A negative value indicates a reduction in regional emissions and, thus, a net improvement in air quality for that pollutant.



Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-9. On-screen instructions for entering bus-idling time.



Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-10. Idle-time calculator.

Net Change in Emissions

Back to Main

	NOx	PM10	VOC	CO	CO2	
Bus running emissions	44.0	0.4	0.4	3.1	7252.8	tons
Bus idling emissions	0.1	0.0	0.0	0.0	20.6	tons
TOTAL Bus Emissions	44.1	0.4	0.4	3.1	7273.4	tons
minus						
Passenger Vehicle Emissions Offset	57.4	1.4	65.2	928.5	21399.2	tons
Net Change in Emissions	**-13.3**	**-1**	**-64.8**	**-925.4**	**-14125.8**	**tons**

Net change in greenhouse gas emissions equivalent to CO2 emitted by -1,443,587 gallons of gasoline per year

Note: A negative change indicates a net reduction in air emissions.

Source: Resource Systems Group, Transit Air Benefits Calculator

Figure A-11. Main results table in the calculator.

At the present time, the calculator only estimates one greenhouse gas—CO_2. The total gasoline equivalent shown in Figure A-11 is equal to the net change in CO_2 multiplied by 102.195 gallons of gasoline combusted per ton of CO_2 emitted.

NMIM calculates emissions for a total of 39 pollutants including criteria pollutants, HAPs, and greenhouse gases. The change in emissions of all these pollutants is shown in the "Results" tab of the workbook. The output for the sample problem shown above is illustrated in Table A-4.

Outside of the calculator, the user can use the results and weight the emissions of each pollutant to create a single non-cancer and cancer health impact score. There are several weighting schemes available.[10]

[10]For weighting schemes, see "Human Toxicity Potentials for Life-Cycle Assessment and Toxics Release Inventory Risk Screening" in *Environmental Toxicology and Chemistry* by E.G. Hertwich, S.F. Mateles, W.S. Pease, and T.E McKone; SETAC 2001; 20(4): 928–39.

Table A-4. Change in running emissions for all pollutants calculated by NMIM.

Net change in running emissions for all pollutants

Pollutant	Bus Running Emissions (tons)	Passenger Vehicle Offset (tons)	Net Change in Emissions (tons)
Ethyl benzene	1.12E-02	1.45E-03	9.78E-03
Styrene	1.95E-03	1.52E-03	4.29E-04
1,3 Butadiene	2.87E-03	4.65E-03	-1.78E-03
Acrolein	3.19E-04	2.67E-03	-2.35E-03
Toluene	7.46E-02	2.32E-03	7.23E-02
Hexane	1.25E-02	3.99E-03	8.52E-03
Anthracene	2.78E-06	2.53E-05	-2.26E-05
Propionaldehyde	3.44E-04	4.42E-03	-4.08E-03
Pyrene	4.08E-06	2.67E-05	-2.26E-05
Xylene	4.17E-02	3.48E-03	3.82E-02
Chromium6	1.46E-06	5.28E-07	9.33E-07
Benzo(g,h,i)perylene	8.41E-07	6.16E-06	-5.32E-06
Indeno(1,2,3,c,d)pyrene	2.52E-07	6.85E-07	-4.33E-07
Benzo(b)fluoranthene	4.00E-07	7.53E-06	-7.13E-06
Fluoranthene	2.99E-06	1.51E-05	-1.21E-05
Benzo(k)fluoranthene	4.00E-07	7.53E-06	-7.13E-06
Acenaphthylene	1.35E-05	2.53E-05	-1.18E-05
Chrysene	3.36E-07	4.79E-06	-4.46E-06
Formaldehyde	5.56E-03	5.96E-02	-5.40E-02
Benzo(a)pyrene	3.36E-07	8.90E-06	-8.57E-06
Dibenzo(a,h)anthracene	0.00E+00	0.00E+00	0.00E+00
2,2,4-Trimehtylpentane	2.61E-02	4.78E-04	2.57E-02
Benz(a)anthracene	3.36E-07	2.74E-05	-2.71E-05
Benzene	2.63E-02	8.00E-03	1.83E-02
Manganese	1.23E-06	8.23E-07	4.02E-07
Nickel	2.66E-06	2.64E-06	1.67E-08
Chromium(Cr3+)	2.19E-06	7.91E-07	1.40E-06
Acetaldehyde	2.10E-03	2.19E-02	-1.98E-02
Acenaphthene	2.40E-06	1.64E-05	-1.40E-05
Phenanthrene	8.33E-06	3.83E-05	-3.00E-05
Fluorene	4.96E-06	3.36E-05	-2.86E-05
Naphthalene	4.43E-04	9.59E-04	-5.17E-04
CO	11.887	3.606	8.281
CO2	273.969	1914.908	-1640.939
Nox	0.735	12.254	-11.519
PM10	0.019	0.769	-0.750
PM2.5	0.009	0.694	-0.686
SO2	0.005	0.200	-0.195
VOC	0.835	0.725	0.110

Note: A negative change indicates a net reduction in air emissions.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation

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